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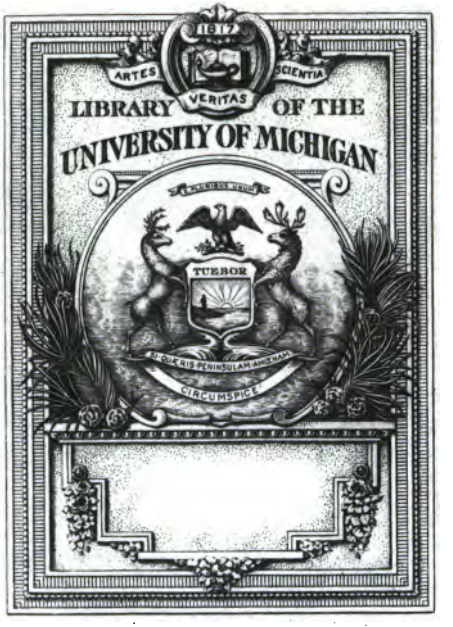

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MARINE AND FRESHWATER FISHES

OF THE

BRITISH ISLANDS

International Fisheries Exhibition

LONDON, 1883

Handbooks, pt. I, no. 2.

HANDBOOK

OF THE

MARINE AND FRESHWATER FISHES

OF THE

BRITISH ISLANDS

(INCLUDING AN ENUMERATION OF EVERY SPECIES)

BY

W. SAVILLE KENT, F.L.S., F.Z.S.

Late Assistant in the Natural History Departments of the British Museum;

AUTHOR OF 'A MANUAL OF THE INFUSORIA,' AND OF OFFICIAL GUIDE-BOOKS TO THE BRIGHTON, MANCHESTER, AND WESTMINSTER AQUARIA

ILLUSTRATED

LONDON

WILLIAM CLOWES AND SONS, LIMITED

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INTRODUCTION.

THE object of this handbook is to place before the reader a brief descriptive summary of the entire fish-fauna of the British Islands. Within the limited space at disposal it has been found impossible in certain instances to give more than an enumeration of the various specific forms, though in most such cases, as exemplified by the Cod-fish, Herring, and Salmon tribes, compensation for this deficiency is made in the corresponding handbooks published or about to be published on the several subjects of "Food Fishes," "Fish Culture," and "Distribution and Consumption of Fish." In a similar manner all complete details relating to the morphological structure and developmental phenomena of fishes have been left in charge of the writers engaged upon the treatises pertaining to "Fish Morphology" and the "Life History of Fishes," while all legislative enactments and statistics concerning our home-fisheries are appropriately relegated to the handbooks entitled "The Law in relation to Fish and Fisheries," and "The Fish Trade of the United Kingdom." Apart from the several topics now enumerated, there remains to be recorded a vast fund of information concerning the habits of fish, their peculiar modes of locomotion, variations and adaptations of form and colour, assumed during their growth to the adult state, or adopted for the purpose of

concealment, and in connection with their breeding seasons; the nest-forming propensities and parental solicitude often displayed in the protection of the eggs and young, usually by the male fish, are all matters of high interest both to the biologist and general reader, that can be studied successfully in connection only with living examples acclimatised in aquaria. Many original observations in this direction, made by the author during the times he held the position of Naturalist and Curator to the several large public aquaria of Brighton, Manchester, Great Yarmouth, and Westminster, and for the most part previously recorded in the columns of 'Nature,' the 'Field,' and the official guide-books written by him for the above-named institutions, have been accordingly embodied in these pages. In this connection attention may be more particularly directed to the accounts here given of the Red Mullet, p. 12, the Black Bream, p. 14, the Angler, p. 25, the Dragonet, p. 50, the Smooth Blenny, p. 59, Whitebait, p. 93, and the Sea Horses, p. 100. In such manner it is anticipated that this little handbook will be found a useful guide to the numerous visitors interested in that highly popular section of the Exhibition buildings, the Aquarium Corridor, flanking the west side of the Horticultural Gardens, and which it is hereafter proposed to retain as a permanent and highly important adjunct of the Science and Art Department. With the assistance of this handbook they will have an opportunity of identifying the various fish exhibited, and of comparing and verifying the descriptions here given of their more remarkable habits and peculiarities. To facilitate such reference and comparison the index at the end of this book will be found to include all the names of the various fishes living in the Aquarium, and whose titles are affixed on tablets at the sides of the tanks.

This handbook has at the same time been compiled with the view of providing a complete reference catalogue or index to the fine series of spirit-preserved British marine and freshwater fishes collected by Dr. Francis Day, which after exhibition in their present position in the East Quadrant will be given to the nation, and placed permanently on view in the Buckland Fish Museum. This museum, it is hopefully anticipated, will on the close of the Exhibition be enriched by many kindred acquisitions. As will be observed, the numbers quoted in these pages in consecutive order after the popular and technical titles of each fish, coincide with the same numbers inscribed on the labels attached to the jars which contain the above-named fish collection, while an extended special description of the individual specimens thus exhibited is frequently given in the text. In like manner, by way of exemplifying certain rare forms, not in the Day Collection, and the larger sizes to which our indigenous fishes not unfrequently attain, reference is constantly made to the magnificent series of coloured plaster casts prepared by the late Mr. Frank Buckland, and to the many preserved specimens contained in the Buckland Museum, now thrown open to the public in conjunction with the Exhibition Courts.

The classificatory system adopted in this handbook accords substantially with that adopted by Professor Huxley in his 'Manual of the Anatomy of Vertebrated Animals,' the diagnosis of the minor subdivisions or families being derived mainly from the special works on fishes by Dr. Albert Gunther and Dr. Francis Day. English readers desirous of extending their acquaintance with the morphology of fish, and with the varieties and distribution of our indigenous icthyological fauna, may advantageously consult the following books, 'The Anatomy of Verte-

brated Animals,' by Professor T. H. Huxley, F.R.S., 1871; Gegenbaur's 'Elements of Comparative Anatomy,' translated and revised by Professor E. Ray Lankester, 1878; 'A History of the Fishes of the British Islands,' by Jonathan Couch, 4 vols., with coloured figure of each species, 1858; 'A History of British Fishes,' by William Yarrell, 2 vols., 1859; 'An Introduction to the Study of Fishes,' by Dr. Albert Gunther, 1880; a 'Familiar History of British Fishes,' by Frank Buckland, 1878; and 'The Fishes of Great Britain and Ireland,' by Dr. Francis Day, F.L.S., F.Z.S., now in course of publication.

The author has, in conclusion, to acknowledge his indebtedness to Messrs. Cassell, Petter & Galpin, the Committee of the Society for Promoting Christian Knowledge, and Messrs. Adam & Charles Black of Edinburgh, for their kind courtesy in supplying him with electrotypes of the wood engravings in their possession, utilised for the illustration of this handbook.

BUCKLAND FISH MUSEUM,
SCIENCE AND ART DEPARTMENT, SOUTH KENSINGTON.
May 22nd, 1883.

MARINE AND FRESHWATER FISHES

OF THE

BRITISH ISLANDS.

CLASS PISCES.—FISHES.

THE class of fishes embraces an extensive series of vertebrated or backboned animal forms exhibiting the utmost diversity in size, form, habits, and organisation. The more highly organised fish types so closely approach structurally certain members of the class Amphibia—including the Frogs, Newts, and Salamanders—as to be with difficulty distinguished from the representatives of that section, while the lowest known type (*Amphioxus*), No. 232, is so deficient in all those characters by which ordinary fish are recognised, and is in other respects so structurally modified, as to form a connecting link with the lower or invertebrate animal series. Defined in its most general and comprehensive sense the class of fishes may be described as a group of vertebrate animals of essentially aquatic habits. The limbs, when present, take the form of two pairs of ventrally developed appendages, which, while homologous with the fore and hind limbs of the higher vertebrata, are not divided in a similar manner by articulations into the distinct regions of arm, forearm, and hand, or

thigh, shank, and foot, as obtains in such higher animals; the wrist-like development of the pectoral fins in the Angler-fishes or Pediculati may be cited among the nearest modifications in this direction. In place of this the limbs are composed, for the most part, of a series of soft parallel bony or cartilaginous rays invested by a continuous expansion of the integument, and thus form efficient paddle-like locomotive organs or fins, the fore and hind pairs of these appendages being known respectively as the pectoral and ventral fins. In addition to these paired fins all fishes invariably possess a greater or less number of median unpaired fins, these are the dorsal or back fins, the anal or vent fins, and the caudal or tail fin. All of these unpaired fins are supported by cartilaginous or bony fin rays, which are joined to the body through the medium of special spinous processes; this structural constitution of the median fins is especially characteristic of fishes, and obtains in no other animals. The heart in all fishes, excepting Amphioxus, consists of a single auricle and ventricle, the blood is cold and red, its component corpuscles being distinctly nucleated, and of an oval shape. All fishes respire the oxygen dissolved in the water by the means of gills or branchiæ. These are supported upon a greater or less number of bony or cartilaginous structures, the visceral arches, developed immediately behind the head, and which are brought into direct relation with the surrounding water in front by the opening of the mouth, and behind by the gill cleft or clefts. The skin, naked in some fishes, is more usually covered with overlapping scales, or may be protected by a series of closely set bony plates, or by variously distributed tubercles or spines. All fishes are dicœcious (bisexual), the majority being oviparous, but some, including notably certain representatives of the Shark tribe,

are viviparous, that is, produce their young alive. The fecundity of fishes is in excess of that of any other division of the animal kingdom. The number of eggs contained in the roe of a single Cod frequently exceeds eight or nine millions, while the roe of a large Turbot weighing twenty pounds was found to contain over fourteen million eggs. The average number of eggs produced by a Salmon having a weight of twenty pounds is twenty-seven thousand, and that of a Herring from twenty to fifty thousand.

The number of known species of fish distributed throughout the salt and fresh waters of the globe falls but little short of nine thousand, out of which as many as two hundred and thirty-two are included in the fish-fauna of

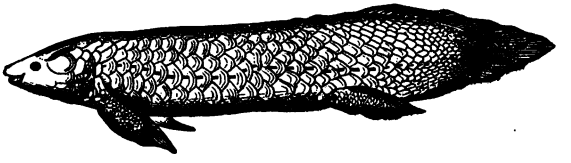

FIG. I.—AUSTRALIAN MUD-FISH (*Ceratodus miolepis*).

the British Islands. Of these, some twenty-eight or thirty are inhabitants of purely fresh water, twelve or thirteen are "anadromous," migrating periodically from salt to fresh water or the converse, while the remainder are exclusively marine forms. The fish class as a whole is sub-divided by our highest authority (see Professor Huxley's 'Anatomy of Vertebrated Animals') into as many as six leading sections or orders. These, commencing with the most highly organised, and descending to the lowest or least specialised group, take the following sequence: I. The Dipnoi or Mud-fishes; II. The Teleostei or ordinary bony fishes; III. The Ganoidei or Sturgeon tribe; IV. The Etasmobranchii, including the Sharks and Rays; V. The

Marsipobranchii, comprising the Lampreys; and VI. The Pharyngobranchii, represented only by that lowest known and very remarkable vertebrate form, the Lancelet, *Amphioxus*. Of the six foregoing groups, but one, that of the Dipnoi, is wanting to our indigenous fauna. This order, which among existing forms includes only the African and American Mud-fishes *Protopterus* and *Lepidosiren*, and the Australian *Ceratodus*, is of especial interest to the biologist, since it constitutes a stepping-stone to the tailed amphibia, or Newts and Salamanders, with which, indeed, anatomically, the species possess many points in common. The African type, *Lepidosiren annectans*, has been frequently brought alive to this country, and several fine casts, illustrating its singular form, are on view in the Buckland Museum. A figure of the yet more remarkable and very recently discovered *Ceratodus miolepis*, inhabiting the fresh waters of Queensland, Australia, is given overleaf. The enumeration and description of our highly representative British fish-fauna may now be proceeded with.

ORDER I.—*Teleostei*.

Fishes having a spinal column that always contains distinctly ossified vertebral centra, and the primordial cartilage of the skull more or less completely replaced by bone.

SUB-ORDER I.—Spine-finned Fishes (*Acanthopterygii*).

A greater or less portion of the rays of the dorsal, anal, and ventral fins not articulated, but represented by sharp-pointed indurated spines; the lower pharyngeal bones usually distinct. Air-bladder in the adult fish without a pneumatic duct.

FAMILY I.—THE PERCH TRIBE (*Percidæ*).

This most highly organised group of the Acanthopterygian or spine-finned fishes, typified by the common Perch of our freshwater ponds and rivers, is represented by five additional British species, all of which, with but one exception, are inhabitants of salt water. The subjoined characters may be cited as common to all its members, and as serving to distinguish them from other spine-finned fishes, which in many points they closely resemble. The body is usually of an oblong form; the branchiostegal rays, supporting the membraneous gill covers, are from five to seven in number; the anterior portion of the dorsal fin is distinctly spinous; the scales are in most instances conspicuously ctenoid or pectinated, and do not extend over the surface of the vertical fins as in the exotic Squamipinnes, e.g. *Chætodon;* the cheeks are not protected by bony plates as in the Gurnards, and there are no filamentous processes, barbels, developed upon the lower jaw as obtains among the next family of the Red Mullets (*Mullidæ*). An air-bladder is almost invariably present.

The Freshwater Perch (*Perca fluviatilis*), No. 1, relegated by most ichthyologists to the first place among the members of its tribe, is too familiar in form to need elaborate description. Its rich ground colour of golden-brown, variegated usually by five or six transversely-set broad bands of black, and bright red ventral, anal, and caudal fins, render it one of the most beautifully marked of our freshwater species. With the angler it is a prime favourite, being of essentially gregarious habits, and taking baits so freely as to afford most excellent sport. In the famous Norfolk Broads, where Perch are very abundant, and grow to large dimensions, it has been observed that the fish assemble

together in shoals according to their sizes, the smaller and larger individuals keeping to themselves, and repelling the intrusion of those that materially differ from them in this respect; a similar phenomenon has been observed in the case of many gregarious marine species. Perch may attain to a weight of as much as five or six pounds, one scaling two pounds, however, being considered a fine fish. The spawn of the Perch is a very beautiful object, and is not unfrequently deposited by the fish in the tanks of aquaria. The individual eggs are very minute, about the size of millet seeds, but when extruded are invested with and

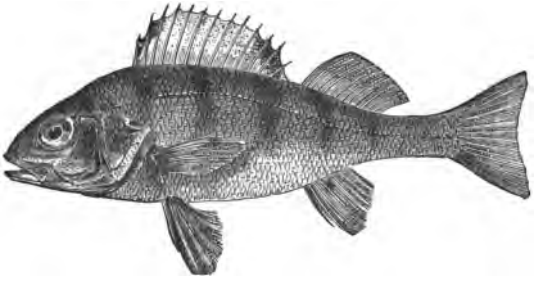

FIG. 2.—THE PERCH (*Perca fluviatilis*).

bound together by a copious matrix of semi-transparent mucilage, and in this form deposited in reticulated lace-like bands upon or among water-weeds or other suitable submerged objects. The spawning season of the Perch ranges from March to June. The number of eggs contained in the roe of two fish, weighing respectively three pounds two ounces and two pounds eleven ounces, was calculated by Mr. Frank Buckland to amount to no less than 155,620 in the former and 127,240 in the latter of the two examples. Casts of these two fish are now on view in the Buckland Museum. Perch obtained from different localities are subject to considerable colour

variation; the characteristic transverse bands may be increased from the more normal one of five or six to as many as eight; in place of being distinct they may combine with each other either superiorly or inferiorly, or they may on the other hand be altogether absent. The American Perch, formerly distinguished by the title of *Perca flavescens*, is now generally recognised to be a variety only of the British and continental species. The only other British freshwater representative of the Perch family is the Pope or Ruff (*Acerina cernua*), No. 3, a fish corresponding closely in its general form with the Perch, but readily distinguished from it by the confluence of what in the Perch constitutes a first and second dorsal fin, and by its more sombre colouring, which consists usually of a ground tint of yellowish brown, diversified with thickly sprinkled black or dark-brown spots. The Pope is a small fish, rarely exceeding a length of four or five inches; the example in the Day Collection, (No. 3B.), measuring as much as six inches, being of exceptional dimensions.

First among the series of fishes belonging to the marine division of the Perch family must be mentioned the Bass or Basse (*Labrax lupus*), No. 2. The silvery sheen of the scales of this fish, combined with its somewhat salmon-like size and proportions, has won for it in various parts of our coasts the local title of the "White Salmon;" and as a variety of such noble fish, the prickly dorsal fin having first been carefully removed, it is not unfrequently foisted upon the uninitiated. Its Latin name of *lupus* or "wolf," which it has inherited from the Romans—its Greek generic title of *Labrax* also signifying a "sea-wolf"—is presumed to have been conferred upon it with reference to its voracious appetite, and to its habit of congregating in shoals, and hunting down the smaller species of fish upon which it

feeds. The Bass grows to a large size, examples of fifteen, sixteen, or even twenty pounds being not uncommon, such finer specimens being mostly taken near the mouths of rivers and the entrances of harbours to which they are especially partial. Though strictly a marine fish the Bass will ascend rivers into brackish water, and, as the writer proved in the tanks of the Manchester Aquarium, may be cultivated in purely fresh water. The ancient Romans, from whom we might even yet take many a useful lesson in the art of pisciculture, were well aware of the accommodating habits of the Bass, and are asserted, on the authority of Columella, to have even bred it in their freshwater ponds. The Bass is one of the few sea species that may be successfully fished for with a rod and fly, excellent sport being obtained with it in this manner, more especially along the rocky coast-line of Devonshire and Cornwall. The cast of a fine specimen of the Bass, length two feet nine inches, weighing sixteen pounds, will be found among the collection in the Buckland Museum.

The Comber or Smooth Serranus (*Serranus cabrilla*), No. 4, met with in tolerable abundance on the coast of Cornwall, is a fish of relatively small dimensions, not exceeding one foot in length, whose aspect, colour, and habits greatly resemble those of the Wrasses (*Labridæ*). As a species of this last-named group, the writer has indeed received it from the above-named locality, in company with living examples of the Ballan, Blue-Striped, and other Wrasses, for stocking the tanks of the Brighton, Westminster, and other Aquaria. The entire absence, however, in the Comber of the protrusile fleshy lips that constitute so prominent a character in the Wrasses, serves at once to distinguish this fish from all members of that family. The ground colour of the Comber is usually a tawny yellow, becoming lighter towards the

ventral region, interrupted by three or four narrow longitudinal bands of a stone-grey or pale-bluish hue which extend from the region of the head to the root of the tail, more or less numerous spots of the same tint decorating the elongated dorsal fin. This fish is not of sufficient size nor sufficiently abundant to be used as food, and when caught is usually cut up for bait. A close ally to the Comber is the so-called Giant Perch or Dusky Perch (*Serranus gigas*), No. 5, a perfect monster compared with the freshwater representatives of the Perch family, attaining in its full growth to a length of three to four feet, and a weight of from sixty to over one hundred pounds. It is a somewhat rare visitor to our shores. The Mediterranean and Atlantic seaboard, as far south as the Cape of Good Hope, being its more ordinarily frequented habitat. The examples so far captured in British waters were taken at Polperro, Falmouth, Penzance, and other points on the Cornish coast. The small example preserved in spirit in the Day Collection is necessarily a very young one. The Stone Bass (*Polyprion cernium*), No. 5, is another of the Sea Perches, local and irregular in its appearance on the British coast, and whose headquarters, as in the preceding form, are to be sought in the Mediterranean and other southern seas, where it attains to a size equal to, or it may be even greater than that of the so-called Giant Perch—examples of as much and even over six feet in length having been recorded. It has been observed as a peculiarity in the habits of the Stone Bass that it is almost invariably captured in the neighbourhood of floating timbers and other wreckage, which it apparently frequents to feed upon the small fish and various Crustacea, Molluscs, and other animals so abundantly associated with the flotsam of the ocean. In a similar manner these fish will also attach themselves to a vessel, whose bottom after

a long voyage has become foul with Barnacles (*Lepadidæ*), and follow her from the high seas to her port of destination. The habit just recorded of the Stone Bass has won for it from the Devonshire fishermen the local title of the "Wreck-fish." The colour of the species is usually a greyish-brown or stone colour, irregularly marked with spots and blotches of a lighter hue. The last fish on the list of the British Percidæ is the Dentex (*Dentex vulgaris*), No. 6; this is likewise only an occasional wanderer to our shores, finding its true home in more southern latitudes; in both shape and in its bright colouration, which consists of various tints of gold, silver, and light blue, it very closely resembles certain members of the *Sparidæ* or Sea-Breams. The long conical so-called canine teeth, developed to the number of four in each jaw, are highly characteristic of this species, and in the larger examples, ranging from three to four feet long—one exposed for sale in the Falmouth fish market in August 1851 measured no less than fifty-six inches—must constitute very formidable weapons of defence.

FAMILY II.—THE RED MULLETS (*Mullidæ*).

Fish of an elongated shape; the branchiostegal rays, supporting the gill membrane, four in number; two long cirrhi or barbels, connected with the hyoid apparatus, dependent from the lower jaw; scales large, entire or very finely serrated; dorsal fins, two in number, widely separated.

The Red Mullet or Surmullet (*Mullus barbatus*), No. 8, with its apparent variety *M. surmuletus*, is the only British representative of this distinct little family group, which includes some forty additional species, for the most part inhabitants of the tropics. The characteristic red or brilliant

pink hue of the fish, as exposed for sale in the markets, is produced artificially by the undoubtedly cruel practice of removing its scales immediately after capture and while still alive, such process causing the permanent contraction and correspondingly more brilliant display of the red pigment contained in the colour-cells or chromatiphores distributed over the surface of the body. A similar brilliant colouration is transitorily exhibited by the fish when dying under ordinary conditions, and it was one of the favourite

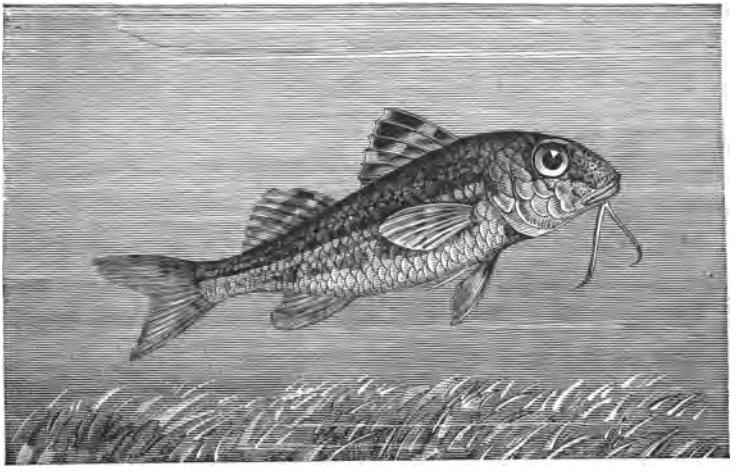

FIG. 3.—RED MULLET (*Mullus surmuletus*).

pastimes of the barbaric Romans to hold banquets for the express purpose of watching the changing colours of the Red Mullet during its death agonies, fabulous prices being paid for examples of more than ordinary size. The epicure Asinius Celer is thus, by way of example, stated to have expended a sum equal to no less than sixty-five pounds of our currency upon a single fish, and even higher prices than this are authentically recorded. The so-called Surmullet or "Striped Red Mullet," which is actually much more abun-

dant on our coasts than the plain Red Mullet, and is distinguished by the presence of from three to five yellow bands developed along each side, from the head to within a short distance of the caudal fin, is now regarded as a local variety only of the uniformly red species or typical *M. barbatus*, which is the more common and most esteemed on the coasts of Toulon and Provence. Some authorities premise that the red is the male and the striped form the female, and others that the latter, being invariably the larger, is alone the full-grown fish. It is, at all events, certain that the two are specifically identical, every intermediate condition between the two having been recorded. Dr. Day, in Part I. of his 'Fishes of Great Britain,' 1880, is unable to express a decided opinion regarding the food of the Red Mullet, authorities differing in this respect, and the tradition of the ancients being that they were very foul feeders, delighting especially to batten, as is the case with Eels, on putrid substances, including corpses. These fish, however, were cultivated in the tanks of the Brighton Aquarium so long since as the year 1873, and their natural habits observed and recorded by the writer in the official guide-book to that Institution, published that same year. It was then shown that shrimps, worms, and other small living marine animals, form the chief staple of their food, the fish assembling in shoals and systematically beating over the whole ground and rockwork of their tanks, after the manner of well-trained sporting dogs, their pliant barbels, used as feelers, being thrust into every crevice in search of their favourite food. No prettier sight, indeed, is afforded in a well-stocked aquarium than "feeding time" at the Red Mullet tank, when a handful of live Shrimps being thrown in, these Crustacea at once bury themselves in the sand, and are thence one by one dislodged by the hungry fish after

careful hunting in the manner above described. On the British coasts the Red Mullet rarely exceeds a weight of from one to two pounds, with a length of twelve or fourteen inches. Occasionally, however, they have been taken over three pounds in weight, and in the Mediterranean they grow to yet larger dimensions.

FAMILY III.—THE SEA-BREAMS (*Sparidæ*).

Body oblong, usually much compressed; scales entire or very minutely serrated; branchiostegal rays, five to seven in number; eyes lateral; teeth usually so differentiated as to constitute a distinct cutting and grinding series; the dorsal fin single, formed by a spinous and soft portion of nearly equal development; the air-bladder present, often bifid posteriorly.

The Sea-Breams, recognised externally by their laterally flattened or compressed form, and by their possession of functionally modified cutting and grinding teeth, are herbivorous and carnivorous fishes, inhabiting the shores of all tropical and temperate seas, as many as nine species occurring in British waters. The majority possess a strong family likeness to one another, and exhibit but little variation in either shape or colour, the prevailing tints being a golden-red, blue or silvery hue, more intense on the back, and thence shading off to the ventral region, a darker spot being sometimes developed immediately behind the head, or upon what may be called the shoulder. In the Spanish Bream (*Pagellus bogarevio*), No. 14, and the *Erythrinus*, or king of the Breams (*Pagellus erythrinus*), No. 17, as exceptions, small thickly distributed spots of a brilliant azure-blue are conspicuously visible throughout the entire dorsal region. Specimens of the last-named very beautiful fish,

obtained from Mevagissey, Cornwall, through Mr. Matthias Dunn, were successfully introduced by the writer in the year 1876 to the tanks of the Westminster Aquarium, being the first and so far only examples of the species thus acclimatised. The Boops or Bogue (*Box vulgaris*), No. 10, is a somewhat aberrant member of the Bream family, which, in addition to its un-Breamlike elongated form, has three or four yellow streaks developed along the sides of the body, parallel with the lateral line; this pattern of ornamentation is, however, shared to some extent by the next-mentioned species. The teeth along the front border of the mouth in the Bogue differ again from those of the ordinary Sea-Breams in having a flattened trifoliate shape. Among the commoner representatives of the Bream family may be mentioned the Black Sea-Bream or Old Wife (*Cantharus lineatus*), No. 9, a species pretty plentifully distributed upon the south and western shores of England, and taken abundantly during the summer months off Brighton. It is usually referred to as a solitary species (Couch, Yarrel, Day, &c.), but such assumption is not supported by the writer's experience, who, when fishing for it with hook and line in the above-named locality, has observed that on one being caught, a rapid succession of captures almost invariably followed, showing that the fish fed in companies. Through a long observation of its habits in the tanks of various aquaria, it has likewise been always found to swim in shoals. In connection with the examples kept at the Brighton Aquarium some data of high interest were observed and recorded by the .writer,* relating to the phenomena of reproduction. On the arrival of the spawning season, which takes place during the early spring months, the full-grown males, separating themselves from

* W. Saville Kent, "On Permanent and Transitory Variations in the Colour of Fish," 'Nature,' May 8th, 1873.

the general shoal, commence excavating deep hollows in the sand and shingle forming the flooring of their large tank, measuring some twenty feet in length and breadth. Each of the males thus separated from his fellows, now mounts guard over his respective hollow and the adjacent area, and vigorously repels, with certain exceptions, the too close approach of every member of the deserted shoal. The exceptions in question are the mature females, which by every means in his power he endeavours to entice within the charmed circle over which he rules supreme, and which is ultimately shown to be a spawning bed, prepared by him for the female fish. One of the most curious circumstances attending these spawning operations, however, is the remarkable transformation of colour undergone by the male. Losing his ordinary attire of silvery grey, he gradually grows darker and darker, until he has assumed the almost black hue characteristic of the fish under ordinary conditions, some time after death, the lips alone remaining ashy pale, and his aspect under these auspices being preternaturally grim. The hatching out of the ova deposited was unfortunately not accomplished, they apparently coming to an untimely end through the attacks of the non-breeding shoal, and as indeed commonly happens where a large number of fish are confined within the limits of an aquarium tank. The hitherto reputed solitary habits of the Black Bream, and also the tradition that the male attaches itself to one mate for life, were thus disproved by these observations : The male, as in the case of the Stickleback, though grim-looking as Othello, proves himself the very gayest of gay Lotharios in his attentions to the fairer sex, and is indeed never so happy as when he can succeed in decoying one female after the other to share the honours of

his deeply excavated bridal abode. As will have been anticipated, the Black Sea-Bream takes its name with reference to the sooty hue it assumes after death, its synonym of the "Old Wife" being a local title by which it is known to south coast fishermen. Among the remaining members of the Sea-Bream family, upon which limited space precludes extension, have to be mentioned the Couches Sea-Bream (*Pagrus vulgaris*), No. 11; the Gilt-head (*Pagrus auratus*), No. 12; the common or Red Sea-Bream (*Pagellus centrodontus*), No. 13; the *Axillary* Sea-Bream (*Pagellus Owenii*), No. 15; and the Acarne (*Pagellus acarne*), No. 16. The majority of these will be found included among the spirit-preserved series in the Day Collection. None of the Sea-Breams are held in high estimation as food-fish, their flesh being coarse and insipid. A length of from twelve to eighteen inches with a weight of five or six pounds represents the average size attained by the adults of the largest members of the Sea-Bream family, such as Nos. 9 and 13, taken on the British coast. The cast of an unusually fine example of the latter form, *Pagellus centrodontus*, having a length of twenty-two inches, and which weighed, when fresh from the sea, no less than eight pounds, is on view in the Buckland Museum.

FAMILY IV.—SCORPION FISHES (*Scorpœnidæ*).

Body more or less compressed; the cleft of the mouth lateral or sub-vertical, furnished with feeble villiform teeth; eyes usually approximated towards the top of the head; a greater or less number of the head bones, and especially those of the pre-operculum, armed with defensive spines, dorsal fin single, its larger anterior moiety spinous; branchi-

ostegal rays five to seven in number; air-bladder present or absent.

The so-called "Norway Haddock," or Bergylt (*Sebastes norwegicus*), No. 18, a fish of Bream-like aspect, but differing from the members of the group last described in the spinous armature of the pre-operculum and other head-bones, and in the feeble, villous character of the dentition, is our only indigenous example of the *Scorpænidæ*. It is a northern deep-water fish, not uncommon off the coasts of Norway, Greenland, and among the Faroe Islands, but becoming rare further south. Full-grown specimens of this type are said to attain to a length of no less than four feet; the example, about eighteen inches long, exhibited in the Day Collection, was captured by the Hull fishermen in March of the present year, 1883. The colour of this fish when living is a bright vermilion or carmine red, becoming lighter towards the ventral region. Although but sparingly represented in British waters, the exotic species of the *Scorpænidæ* are exceedingly numerous, widely distributed, and wonderfully diverse. Thus, while our indigenous *Sebastes* more nearly simulates a Bream in both form and habits, the typical genus *Scorpæna* includes some forty tropical or sub-tropical species, that more closely resemble in some respects the *Cottidæ*, or Bullheads, and in others, the Anglers, or *Pediculati*, being devoid of an air-bladder, and leading like them a sedentary life at the bottom of the ocean. Many of them, in a similar manner, have their skins wonderfully marbled or mottled, and are commonly adorned in the region of the head with simple or variously branched membranous appendages. In *Chorismodactylus* again, which in other respects agrees closely with *Scorpæna*, the three anterior rays of the pectoral fins are freely movable, and so constructed that the fish is enabled with their aid to

walk upon the ground at the bottom of the sea, the modification in this species being therefore in the direction of the Gurnard family next described.

FAMILY V.—The Bullheads and Gurnards (*Cottidæ*).

Body oblong, sub-cylindrical; the skin naked or scaled; the head usually abnormally large and broad, armed with defensive spines; the mouth furnished with bands of feeble villiform teeth, its cleft lateral; the eyes lateral or approximated towards the top of the head; dorsal fin more generally double, its spinous portion being the less developed; branchiostegal rays from five to seven in number; air-bladder present or absent.

The genus *Cottus*, including the Bullheads and that of *Trigla*, embracing the Gurnards or Mail-cheeks, are the only representatives of the family found in British waters; the group otherwise is abundantly developed throughout the Arctic, Temperate, and Tropical seas, the majority being inhabitants of shallow water. The Bullheads, remarkable for their large, ungainly heads, which when disturbed they are capable of still further distending, and thus opposing as defensive weapons the sharp spinous processes with which the pre-operculum more especially is armed, are somewhat repulsive-looking fishes, found usually lurking among stones in the neighbourhood of the shore. Being destitute of a swimming bladder, they are incapable of supporting themselves for any length of time in mid-water, and are in the habit of lying in wait behind stones, seaweeds, and other submarine objects, and thence pouncing out upon their unsuspecting prey. The Bullheads are exceedingly voracious fish, scarcely any animal organisms coming amiss to

them, and Blennies, Gobies, and other fishes of at least half their own size, being the common food of the marine species. A single freshwater variety, the little Miller's Thumb, or river Bullhead, No. 19, is pretty plentifully distributed throughout the clear streams and rivers of Great Britain, but where it rarely attains a greater length than three or four inches. In addition to the preserved specimens in the Day Collection, living examples of this species will be found in the large window aquarium in the Buckland Museum. The marine varieties include the so-called Father-lasher, Sea-Scorpion, or common Sea-Bullhead (*Cottus scorpius*), No. 20, a beautifully mottled variety, which while on our shores, not known to exceed fifteen inches in length, is reported to attain to four or five times these dimensions upon the coast of Greenland. This variety has been described by Couch under the title of *Cottus grœnlandicus*. The spawn of the Sea-Bullhead, which consists of a closely united mass of small yellow eggs, having much the appearance of boiled sago, are often met with under stones within tide-marks, and have frequently, within the writer's experience, been deposited by the fish in the tanks of aquaria. The long-spined Bullhead or "Lucky Proach" (*Cottus bubalis*), No. 21, closely resembles the preceding species, but has longer head spines and frequents deeper water, while the Four-horned Bullhead (*Cottus quadricornis*), No. 22, is a rare form, seldom entering British waters, and confined almost exclusively to the Artic regions.

The second division of the *Cottidæ*, represented by the Gurnards, genus *Trigla*, are exclusively salt-water fish, distributed extensively throughout the Temperate and Tropical seas. As many as six species are included in the British list, all of which are esteemed for food. A very

remarkable structural feature in the Gurnards is connected, with the peculiar modification of the pectoral fins, certain, usually three, of the rays of which are detached from the others, separately movable, and so constituted that they form ambulatory organs, wherewith these fish are in the habit of literally walking along the bottom of the sea. This assertion may be easily verified by a brief observation of their habits in the tanks of an aquarium. The remaining pectoral rays, united by membrane and

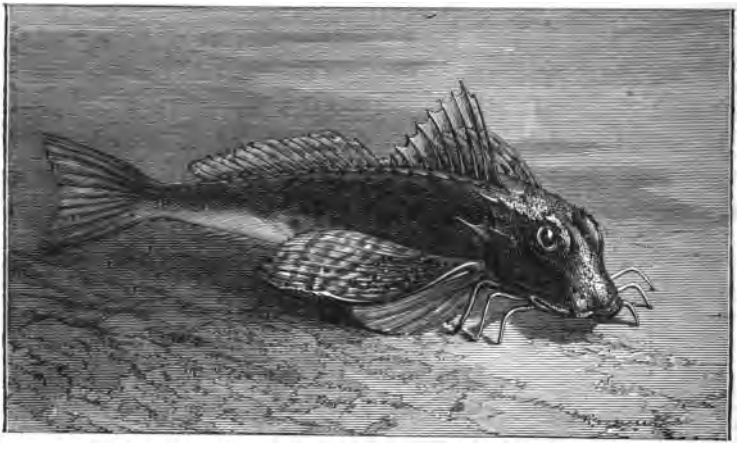

Fig. 4.—STREAKED GURNARD (*Trigla lineata*).

forming the true fin, are also very largely developed, and in an allied exotic genus, *Dactylopterus*, to such an abnormal extent, that the fish is enabled with their aid to take long leaps above the surface of the water, and is comprised within the category of so called Flying-Fishes. In many of the British Gurnards, the upper surface of the large pectoral fin is beautifully and brilliantly coloured, and notably in the so-called Sapphirine Gurnard (*Trigla hirundo*), No. 25, in which this region is ornamented with a central ocellus, and surrounding markings of various shades

of dark and palest blue; these fins vying, as a whole, in brilliancy with the resplendent wings of the most gorgeous tropical butterflies. To see this remarkable colouring to its greatest advantage, it is requisite to look upon these fish vertically through the water; and no more interesting and attractive adjunct to a marine aquarium could be introduced than a shallow salt-water pond, exposed to the full light of day, devoted to the exhibition of the various members of the Gurnard tribe. The remarkable leg-like conformation of the elements of one portion of the pectoral fin, and the wing-like aspect of the other, is well illustrated in the spirit-preserved example (No. 23a) of the Streaked Gurnard (*Trigla lineata*). The remaining British members of the genus *Trigla* are the red Cuckoo Gurnard (*T. cuculus*), No. 24; the common Grey Gurnard (*T. gurnardus*), No. 26; the Piper Gurnard (*T. lyra*); and the Lanthorn Gurnard (*T. obscura*). Many of the Gurnards possess the faculty of emitting a dull croaking sound, both beneath and immediately after being taken out of the water, said to be caused by the forcible ejection of gas from their air-bladder by a duct which communicates with the gullet. With reference to this peculiarity, the common or Grey Gurnard is distinguished in Scotland by the title of the "Crooner," or "Croonach," a derivative from the Gaelic verb "croon" to croak. Gurnards of the largest size measure as much as or even over two feet, but from one foot to eighteen inches is the more average adult length of our British species. Preserved examples of nearly all our indigenous forms will be found in the Day Collection.

FAMILY VI.—MAILED GURNARDS (*Cataphracti*).

Body elongated, sub-cylindrical or angular, invested with a complete cuirass of keeled osseous scales or plates; the

head armed with projecting spines, the dentition feeble; branchiostegal rays six or seven in number; air-bladder present or absent.

Two genera only, each represented by but a single species, are found in the British waters. In the one form, known as the Armed-Gurnard (*Peristethus cataphractum*), No. 60, the similarity to an ordinary Gurnard is very great, a certain number of the pectoral fin rays being in a like manner freely detached and subserving as ambulatory organs. This species, while moderately abundant in the Mediterranean where it grows to a length of two feet, is exceedingly rare on the British coast; the example on view in the Day Collection was presented to the exhibitor by Dr. Hubrecht of the Leyden Museum. The second type, or Armed-Bullhead (*Agonus cataphractus*), No. 29, is a small species rarely exceeding a length of six inches, and is very plentiful on the shallow, sandy shores around our coasts. But for its mail-clad body it might be easily mistaken for one of the ordinary Bullheads, it being destitute of the free, leg-like pectoral rays that characterise the preceding form. Among the exotic members of the *Cataphracti* are included the remarkable Flying Gurnards, in which the pectoral fins are so abnormally developed that the fish are enabled by their aid to take short flights, or more correctly long leaps, above the surface of the water. These Flying Gurnards, referable to the genus *Dactylopterus*, exclusively inhabit the Indian Ocean and other tropical waters, it being another Flying-fish (*Exocetus volitans*), which more nearly resembles a Herring, that is met with in temperate latitudes.

FAMILY VII.—ANGLER FISHES (*Pediculati*).

The head and anterior region of the body of abnormal size; teeth relatively minute, villiform or cardiform; the gill-opening reduced to a small foramen situated in or near the axilla; the spinous dorsal fin developed far forward, represented by a few isolated spines only, which frequently present the appearance of tentacles; the carpal-bones at the base of the pectoral fin prolonged in an arm-like manner. The surface of the skin scaleless, or armed only with small scattered spines or tubercles; branchiostegal rays five or six in number; an air-bladder present or absent.

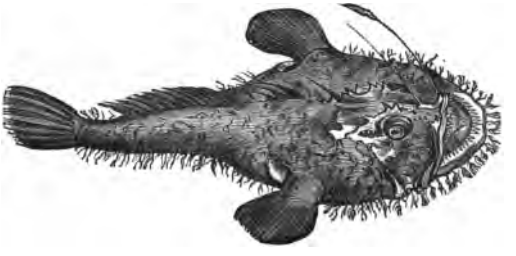

FIG. 5.—ANGLER (*Lophius piscatorius*).

The well-known Angler, Fishing-Frog, Sea-Devil or Toad-fish as it is variously called (*Lophius piscatorius*), No. 31, is the only British representative of the remarkable group of fishes distinguished by the title of the *Pediculati*. The singular conformation of the bones of the fore-limbs —corresponding with those of our wrists—convert these structures as a whole, which in ordinary fishes remain as simple fins, into leg-like organs, with which the fish can creep slowly about at the bottom of the sea, while some of the foreign forms, genus *Antennarius*, familiarly known as Walking-fishes, actually perambulate the shore when the tide goes down in search of food. Scarcely less extraordinary

is the modification throughout the *Pediculati* of the spinous first dorsal fin, the anterior rays of which are developed separately, so far forward as to be even in front of the eyes; one of them mostly bearing at its free extremity the laminate membraneous appendage, which, in conjunction with its supporting ray, is usually described as the "rod and bait," from whence the European Angler, in particular, derives its popular name. A very remarkable osseous ring-joint at the base of this first spinous ray interlocks into a similar ring developed from the substance of the skull; this arrangement admits of the free play to and fro, with the current of the ray in question, and no doubt assists in maintaining the illusion presently described. That the fish deliberately used this structure, as a fisherman does his rod and line, for the purpose of alluring and capturing other smaller fish, is a matter of tradition handed down to us from the time of Pliny and Aristotle, and which scarcely any authority since their time has ventured to gainsay. Nevertheless, like many of the delightful natural history romances bequeathed to us by the ancient philosophers—that of the asserted navigating habits of the Paper Nautilus being a prominent illustration—this one of the Angler-fish will, it is anticipated, have to be relegated to the limbo of disproved fiction. The plain and certain ground of facts, all the same, has frequently more startling revelations in store for us than the most fervid imaginations of philosophers, and that this assertion holds good in the case now under consideration must undoubtedly be admitted. It is here proposed to show, in fact, that the Angler is one of the most interesting examples upon which nature has exercised her handicraft, in the direction of concealing the identity of her *protégé*, such ingenuity being sometimes utilised with the object of protecting the organism

from the attacks of other animals, or, as illustrated in the present instance, for the purpose of enabling it by stealth to obtain prey, which it lacks the agility to hunt down after the manner of ordinary carnivorous fishes. To recognise the several details here described, it will not suffice to refer to examples simply—and usually most atrociously—stuffed, nor even to those preserved in spirit, in which all the life colours are more or less completely obliterated, and the various membraneous appendages shrunk up and distorted. In place of this, a healthy living example fresh from the sea, or better still, acclimatised in the tanks of an aquarium, must be attentively examined, and whereupon it will be found that this singular fish throughout the whole extent of its superficies may be appropriately designated a living sham. Such an example of the Angler, measuring no less than four feet long, imported by the writer to the tanks of the Manchester Aquarium in November 1874, furnished the material for an article communicated by him to the 'Field,'* in which the greater portion of the data here submitted were first described. It was in the first place observed on that occasion that the fish, while quietly reclining upon the bottom of its tank, presented a most astonishing resemblance to a piece of inert rock, the rugose prominences in the neighbourhood of the head lending additional strength to this likeness. This resemblance being recognised, it was next found, on a little closer inspection, that the fish constituted in connection with its colour, ornamentations, and manifold organs and appendages, the most perfect facsimile of a submerged rock, with that natural clothing of sedentary animal and vegetable growths, common to boulders lying

* W. Saville Kent, "On an Angler at the Manchester Aquarium," 'Field,' November 14, 1874: *ib.* Westminster Aquarium, 'Field,' November 7, 1876.

beneath the water, in what is known as the Laminarian Zone. In this manner the numerous simple or lobulated membraneous structures, dependent from the lower jaw, and developed as a fringe along the lateral line of the body, imitate with great fidelity the little flat calcareous sponges (*Grantias*), small compound ascidians, and other low-organised zoophytic growths that hang in profusion from favourably situated submarine stones. That famous structure, known as the angler's "rod and bait," finds its precise counterpart in the early growing phase of certain sea-plants such as the oar-weed (*Laminaria*), while the more posterior dorsal fin rays, having short lateral branchlets, counterfeit in a like manner the plant-like hydroid zoophytes, known as *Sertulariæ*. One of the most extraordinary mimetic adaptations was, however, found in connection with the eyes, structures which, however perfectly the surrounding details may be concealed, serve, as a rule, to betray the animal's presence to a close observer. In the case of the Angler, the eyes during life are raised on conical elevations, the sides of which are separated by darker longitudinal stripes into symmetrical regions, the structure as a whole, with its truncated summit upon which the pupil opens, reproducing with the most wonderful minuteness the multivalve shell of a rock-barnacle (*Balanus*). To complete the simile the entire exposed surface of the body of the fish is mapped out by darker punctated lines into irregular polygonal areas, whose pattern is at once recognised by the student of marine zoology as corresponding with that of the flat, cushion-like expansions of the compound tunicate, *Botryllus violaceus*. Thus disguised at every point, the Angler has merely to lie prone as is its wont* among

* The picture reproduced in even many recent popular Natural History Works of the Angler poised tranquilly in mid-water, fishing for

the stones and débris at the bottom of the sea, and to wait for the advent of its unsuspecting prey, which, approaching to browse from what it takes to be a flat rock—differing in no respect from that from off which it obtained the last appetising morsel of weed or worm—finds itself suddenly engulphed beyond recall within the merciless jaws of this marine impostor. The voracity of the Angler is proverbial, the enormous width of its gape and the great elasticity of its integument permitting it to seize and devour fish of other species almost equal to itself in bulk. Of smaller fish no less than three-quarters of a hundred of herrings, and in another instance twenty-one flounders and a John Dory, have been taken from the stomach of a large Angler. When greatly pressed with hunger examples have been known to ascend and seize gulls and other sea-birds floating on the surface of the water, while they not uncommonly gorge the fish already caught on the fisherman's lines. Adult examples of the Angler are reported to attain a length of six or seven feet, from three to four feet being, however, a more common measurement. In the Buckland Museum will be found the cast of a specimen measuring no less than five feet two inches, while another cast of a smaller fish represents an example captured in the act of swallowing a Bass, scarcely inferior to itself in length. The additional sobriquet of the "Pocket-fish" has been conferred by fishermen upon the Angler, with reference to the pouch-shaped branchial cavities with which the minute gill-opening communicates. Tradition has ascribed to these branchial pouches a variety of functions, one being that they subserved as pockets,

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its prey, is altogether erroneous and impossible; the species possesses no air-bladder, and unless laboriously engaged in propelling itself through the water with its caudal fin, sinks helplessly to the bottom.

wherein the fish stowed away any superabundant supply of food, and another that they supplied refuges to which the young retreated for safety when alarmed. As a matter of fact these gill pouches are almost invariably found to contain examples of that interesting parasitic crustacean *Lerneotoma lophii*. The spawn of the Angler is reported by Professor Spencer Baird, of the United States Fishery Commission, to form a floating sheet of mucous of from

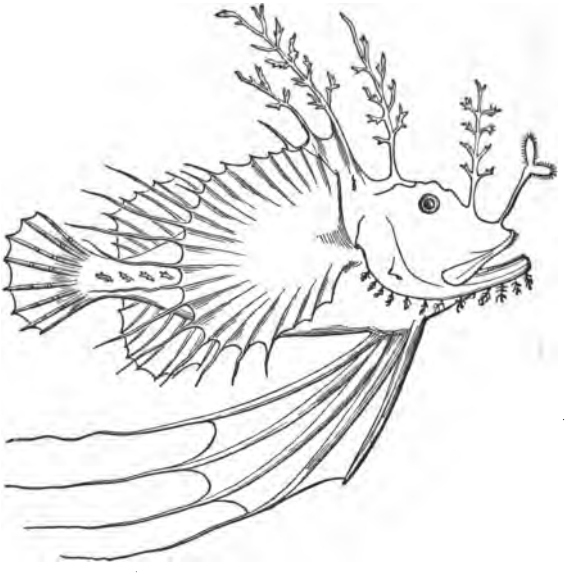

FIG. 6.—YOUNG ANGLER (*L. piscatorius*).

sixty to one hundred feet square, the number of ova computed to have been contained in such a mass deposited by a specimen measuring four and a half feet long, being no less than 1,427,344. The earliest pelagic condition of the Angler, as shown in the accompanying figure, differs in a remarkable manner from the parent form, and more especially in the luxuriant development of the fins and fin rays.

FAMILY VIII.—WEEVER-FISHES (*Trachinidæ*).

The body more or less elongated and compressed; certain bones of the head usually armed with spines, the preoperculum without a bony stay; the teeth minute, villiform; one or two dorsal fins, the anterior spinous portion being always the shorter; an air-bladder generally absent; branchiostegal rays varying from five to seven in number.

The Weever-fishes, of which there are two British representatives, the Greater Weever (*Trachinus draco*), No. 32, and the Lesser Weever (*Trachinus vipera*), No. 33, enjoy the unenviable reputation of being the only fish indigenous to this country that possess undoubted poisonous properties. Although not provided with true poison glands, like the exotic genus *Uranoscopus* and its allies, it has been demonstrated that the mucous membrane in the immediate neighbourhood of the opercular spines and the spinous dorsal fin excrete an active virus that render wounds from these fish, and more especially the smaller Weever, exceedingly painful and even dangerous. On the Continent, where the larger species is commonly exposed for sale in the markets, an enactment exists requiring the prior removal of these formidable spines. The most efficacious antidote for wounds received from the Weever has been found, in modern times, to be olive oil, to which a few drops of opium have been added. In ancient days a so-called "tisane," thickened with the brains of the offending fish or the body of the fish itself cut open and applied to the wound, were reckoned among the more effective remedies. The two species of Weevers are inhabitants of the sandy shores around our coasts, the larger variety, attaining a length of from twelve to seventeen inches, inhabiting deeper

water; and the smaller form, rarely exceeding the dimensions of four or five inches, occurring abundantly close to land.

Among the titles by which the last-named form is locally recognised may be mentioned those of the Adder-Pike, Black-fin, and Sting-fish; that of the Cat-fish and Sting-bull being applied in a like manner to the larger variety. The colours in the two species closely correspond, consisting of a grey or yellowish ground-tint, darkest on the back, and ornamented on the sides by numerous oblique lines of blue, brown, and yellow; the spinous dorsal fin, as a marked contrast in both types, being an intense black—this last-named peculiarity is well shown in the spirit-preserved examples in the Day Collection.

FAMILY IX.—THE MACKEREL TRIBE (*Scombridæ*).

Body usually elongated, spindle-shaped, slightly compressed, naked or covered with minute scales; teeth well developed, pre-operculum without a bony stay, the bones of the head not armed with defensive spines; dorsal fins two in number, the second one and also the anal fin, usually separated posteriorly into a number of minute finlets; branchiostegal rays seven or eight in number; an air-bladder present or absent.

The members of the Mackerel tribe, as edible fishes, take equal rank with those of the Herring and Cod families, and are accordingly made the subject of special notice in the Handbook devoted to the food species. All are of essentially pelagic habits, abounding, usually in shoals, throughout the Temperate and Tropical seas, and subsisting on other marine fishes. The common Mackerel (*Scomber scomber*), No. 34, which may be taken as the type of its

tribe, is captured off our coasts throughout the year, while at certain seasons it approaches the shores in prodigious numbers, impelled by instincts connected with their breeding habits, or in pursuit of the shoals of young *Clupeidæ*, Herrings, Pilchards, &c., upon which they in large measure subsist. The gorgeous colouring of a Mackerel taken freshly from the water almost defies description or reproduction with the artist's brush. The dorsal region reflects the most brilliant metallic shades of green and blue, intersected by some three dozen narrow V-shaped bands, which pass obliquely forwards towards the lateral line; a single dark stripe is usually developed from the pectoral fin along the course of but a little beneath this line, while the whole surface of the sides and abdomen below this point are iridescent with every colour of the rainbow—purple, gold and silvery shades struggling for the mastery. Sometimes this lower region of the body is variegated with small spots and blotches, while well-marked varieties, formerly regarded as distinct species, and described under the titles of the "Scribbled" and "Dotted" Mackerel, have the more customary dorsal bands replaced by a uniform series of black dots or scribblings. These several varieties will be found well represented among the preserved examples in the Day Collection. From fourteen to sixteen inches is the ordinary length of the common Mackerel, examples measuring eighteen inches being of very rare occurrence. Some idea of the abundance of this valuable food-fish may be gained from the record, that as many as 300,000 were, in May 1868, netted in one morning off the Scilly Isles. The Spanish Mackerel (*Scomber colias*), No. 35, much resembles the common species, but grows to a considerably larger size, and is only an occasional wanderer to our shores, its headquarters being the Mediterranean. Among the

preserved specimens of the common Mackerel in the Day Collection is an example, No. 34 c, round the body of which, on its first capture, an indiarubber ring had been fastened and the fish returned to the sea; as subsequently caught and now exhibited, the ring has constricted the body at the point of contact to about one-half its natural girth. No interference with its ordinary vital functions had apparently resulted from this novel experiment in tight lacing.

Closely allied to the Mackerels, but vastly exceeding them in dimensions, are the various species of Tunnies and

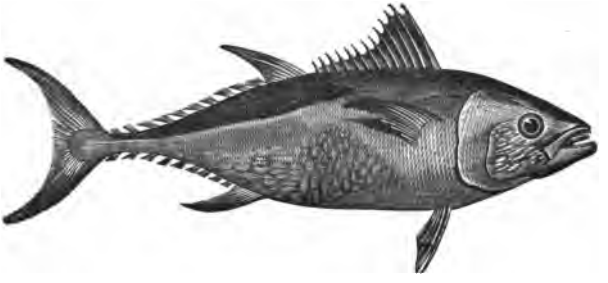

FIG. 7.—TUNNY (*Orcynus thynnus*).

Bonitos. While but occasional visitants to British waters, their capture and preservation, more especially that of the Common or Short-finned Tunny (*Orcynus thynnus*), No. 36, constitutes one of the most important fishing industries along the Mediterranean sea-board. A length of from eight to nine feet, with a weight of 500 to 1000 pounds and upwards, are the ordinary dimensions and weights of adult examples of the Common Tunny, though these may be greatly exceeded. The cast of an example of this species, measuring eight feet, captured at Dawlish, Devonshire, is on view in the Buckland Museum. The remaining members of the Mackerel family, that like the Common Tunny are

only irregular wanderers to our shores, are the Long-finned Tunny (*Orcynus germo*), No. 37; the Bonito (*Thynnus pelamys*), No. 38; the Short-finned Tunny or Pelamid (*Pelamys sarda*), No. 39; and the Plain Bonito (*Auxis rochei*), No. 40. Young examples of the greater number of these species will be found among the spirit series in the Day Collection. A remaining very remarkable fish, referred by most authorities to the *Scombridæ*, but which possesses but few points in common with the typical Mackerels, is that species of sucking-fish known as the Common Remora (*Echeneis remora*), No. 41. This fish differs from the sucking-fishes belonging to the family *Discoboli* in that the adhesive organ or acetabulum is

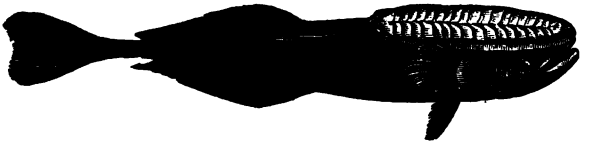

FIG. 8.—SUCKING-FISH (*Echeneis remora*).

developed dorsally, immediately on the crown of the head, instead of upon the ventral surface of the body, being, indeed, a peculiar modification of the anterior dorsal fin. The habits of the Remora are very singular, it not being a free roving fish, but always found in company with larger species, such as members of the Shark tribe, to which they affix themselves by their dorsal sucker, swimming off momentarily to obtain food, and returning again to the shelter of their selected hosts. In like manner these fish will also attach themselves to vessels, sometimes to the number of several hundreds, finding an abundant supply of food in the kitchen grease and garbage of an even less savoury description that is more or less continually thrown overboard. From the classic days of Ovid and Pliny, to

within a comparatively recent date, it was implicitly believed that a Remora, by fixing itself to the bottom of a vessel, was able to retard or arrest its progress, this miraculous property being made accountable by some authorities for that inactivity of the ship commanded by Mark Antony which lost him the famous battle of Actium: a Remora, at an early hour of the engagement, having, it was asserted, affixed itself to the keel of his vessel. This variety of sucking-fish is essentially an accidental visitor to our coasts, its true home being the warmer seas of the tropics; the Blue Shark (*Carcharias glaucus*) is the fish with which, following its natural habits, it has been usually found associated when captured in British waters.

FAMILY X.—BLACK-FISHES (*Stromateidæ*).

Body oblong, compressed, covered with very minute scales; dentition feeble; the œsophagus armed with numerous barbed, horny processes; the pre-operculum without a bony stay; the dorsal fin single, elongate, without a distinct spinous subdivision; branchiostegal rays seven in number.

This family contains but a small number of pelagic fish, two of which are rarely taken in British waters. These are the Cornish Centrolophus (*Centrolophus britanicus*), No. 42, and the Black-fish (*Centrolophus pompilus*), No. 43. The last-named species is remarkable for being generally captured in attendance upon certain of the larger Sharks, or even vessels, after the manner of the true Pilot-fish. The fish takes its name from the exceedingly dark umbrageous hues it assumes when dead; it attains to a length of from two to three feet. Examples of both species of *Centrolophus*, must be placed on the list of desiderata for the Museum of Economic Pisciculture.

FAMILY XI.—DOLPHIN FISHES (*Coryphænidæ*).

Body compressed, oblong, or elongated; teeth small, conical; the œsophagus unarmed; no bony stay to the pre-operculum; the dorsal fin single, elongate, without a distinct spinous portion; branchiostegal rays five to seven in number.

This family group takes its name from the so-called Dolphin (*Coryphæna hippurus*) of the Mediterranean and sub-tropical seas, from whence is derived that conventional representation of the Dolphin so largely utilised for artistic purposes from early days to the present time. It is not to be confounded with the true Dolphin (*Delphinus*), which is not a fish but a small cetacean, or member of the Whale tribe. The only British representatives of the *Coryphænidæ*, and these being but accidental stragglers from deeper or warmer seas, are Ray's Bream (*Brami Rayi*), No. 44, of which an example will be found in the Day Collection, and also a cast in the Buckland Museum; the Opah, or King-fish (*Lampris luna*), No. 45, a compressed, Dory-shaped fish, resplendent with every colour of the rainbow, the back being bluish-green, the sides violet, fins and tail bright red, and large oval silvery spots being distributed irregularly over the entire surface of the body; and lastly, the Diana-fish (*Luvarus imperialis*), No. 46, a species which, having in the adult state an elongated body and elevated forehead, very nearly resembles the typical "Dolphin" (*Coryphæna*) of the Mediterranean. The capture of but two examples in British waters has been so far recorded, both from the Cornish coast. One of these, measuring three feet nine inches, has been deposited in the British Museum. Its colours in life, like those of the *Coryphæna*, are very brilliant, those of the

specimen above referred to, as described by Mr. Cornish ('Zoologist,' p. 500, 1866), being—back, steel-grey; a broad, scarlet band along the sides, which are likewise, as it were, sprinkled with gold dust; the abdomen silvery, fins and tail bright crimson. The young of this species differ so remarkably in shape from the parent form, that it was up to within a recent date regarded as a distinct fish, and figured and described in works on ichthyology under the title of *Diana semilunata*. Several very superiorly stuffed examples of the Classic Dolphin (*Coryphæna hippurus*) are included among the fine collection of Indian fishes brought to this country by H.R.H. the Prince of Wales, when returning from his famous Indian tour, in the year 1876, and which, after exhibition at the Zoological Society's Gardens, he generously deposited as a loan in the Buckland Museum. This Indian collection will be found well worth the visitor's attention; the skill with which many of the fish have been preserved by native taxidermists being rarely surpassed by British artists.

FAMILY XII.—HORSE MACKERELS (*Carangidæ*).

Body more or less compressed, oblong or elevated; teeth conical; the pre-operculum without a bony stay; the spinous dorsal fin continuous with or separated from the more considerable softer portion; no extensive series of dorsal and anal finlets as in the true Mackerels; a more or less complete row of keeled, spine-bearing plates or scales usually developed along the lateral line; branchiostegal rays seven in number.

The Scad, Horse-Mackerel, or Bastard Mackerel (*Caranx trachurus*), No. 47, enjoys an almost cosmopolitan distribution, and is occasionally so abundant on our south-

western coast-line, that as many as ten and even twenty thousand have been enclosed and brought to land at a single haul of the seine. This fish is but little valued for the table. Its distinction from the common Mackerel may be at once recognised by the absence of the series of minute dorsal and ventral finlets in the region of the tail, which characterise the last-named species, and also by the presence of a row of sharp, spinous scales or plates, which form a continuous series throughout the entire length of the lateral line. Twenty inches represent the longest dimensions attained by the adult Scad; its colour is usually dull blue along the back, and silvery beneath the lateral line. The well-known Pilot-fish (*Naucrates ductor*), No. 48, is so called by reason of its characteristic habit of associating with various species of Sharks, which fish it is asserted to swim in front of, and guide to its prey. On this account it is popularly known among sailors as the "Shark's provider." In illustration, however, of the fact that the partnership established between the two fish is not always to the advantage of the Shark, it has frequently been known to entice its bulky companion to swallow a baited hook, which it would otherwise have left unnoticed. The Pilot-fish, like the Remora, frequently attaches itself to vessels for the sake of the discharged garbage, following them with such perseverance as to be often brought into harbour. On one occasion two Pilot-fish were thus known to accompany a sailing-vessel during a voyage of eighty days, between Alexandria and Dartmouth, they having become so tame on its arrival at the latter port, that they were easily captured, and, it is a matter of regret, killed and eaten. The Pilot-fish rarely exceeds a small Mackerel in dimensions, its colour being likewise somewhat similar, consisting of a bluish-grey ground, variegated by five or six broad transverse

bands of a darker hue. The Rudder-fish, or Black Pilot (*Pammelas perciformis*), No. 49, and the Derbio, or Glaucus Mackerel (*Lichia glauca*), No. 50, are two rarer forms, somewhat resembling the true Pilot-fish, but with relatively shorter bodies, that are usually referred to the *Carangidæ*, and lead the way to the compressed, short-bodied species known as the Boar-fish, or Cuckoo-fish (*Capros aper*), No. 51. This little fish, which in shape much resembles a John Dory, but rarely exceeds six inches in length, and is usually coloured a bright orange-red, with occasionally a variable number of darker vertical bands, is not uncommon off the Cornish coast, preferring moderately deep water in the neighbourhood of rocks. Though of no value as a food-fish, it is a great favourite for exhibition in aquaria, its quaint shape, bright colours, and habit of swimming fearlessly in the middle of the water, rendering it specially suited for such a purpose. It has been observed by the writer, of examples imported by him from Mr. Matthias Dunn, of Mevagissey, Cornwall, to the Brighton, Manchester, and Westminster Aquaria, that the ordinary slow locomotion of the Boar-fish, as in the case of the John Dory, is accomplished solely by the screw-like undulations of the soft-dorsal and anal fins.

FAMILY XIII.—THE DORY TRIBE (*Cyttidæ*).

Body elevated, greatly compressed; naked, or covered with small scales or bucklers; teeth, small, conical; no bony stay to the pre-operculum; the dorsal fin composed of a distinct, soft and spinous portion; branchiostegal rays seven or eight in number.

This small marine group contains less than a dozen existing species, referable to the two genera *Zeus* and

Cyttus, and of which but one form, the well-known John Dory (*Zeus faber*), No. 52, is an inhabitant of British waters. Its popular name is apparently a corruption of the French "Jaune Dorée," significant of its typical hue of golden-yellow. The large, dark circular spot, with a surrounding lighter annulus developed immediately behind the pectoral fin, gave rise in earlier days to the tradition that this fish represented the species from which St. Peter obtained the tribute-money, the spot on each side

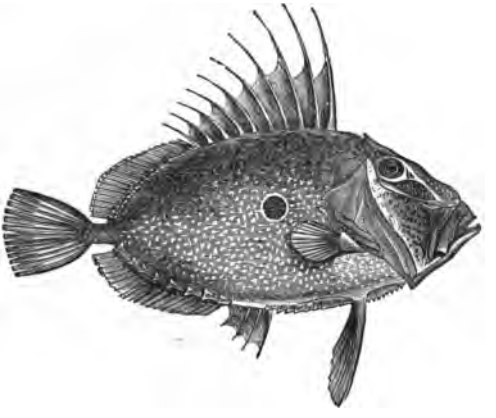

FIG. 9.—JOHN DORY (*Zeus faber*).

being regarded as inherited marks left by the Apostle's finger and thumb when capturing the fish. Unfortunately for the tradition the Dory is not an inhabitant of Lake Gennesaret whence the fish was taken, while a like distinctive mark is common to numerous marine and freshwater species. The high reputation enjoyed by the Dory as a table delicacy will be found duly chronicled in the handbooks treating of fish as food. The habits of the species as observed by the writer, of several examples successfully introduced into the tanks of the Brighton Aquarium, are

highly interesting. The manner in which the Dory swims, by the rapid undulation of the soft dorsal and anal fins only, referred to in the account given of the Boar-fish, was recorded by the writer so long since as the year 1873,* the only species of which a very similar mode of locomotion, by means of the unpaired fins, had been hitherto observed, being the Sea-horses and Pipe-fishes, belonging to the Family *Syngnathidæ*. As a rule, when undisturbed, the Dory remains perfectly quiescent in mid-water in the vicinity of the rockwork of its tank, and against which it frequently leans for support. Like the Angler it is a fish that captures its prey by stealth, and not by the exercise of superior activity. That the Dory is a most voracious feeder, is exemplified by the fact that as many as twenty-five young Flounders and three half-grown Sea-Bullheads have been abstracted from the stomach of an example measuring only twelve inches and a half in its total length; while another Dory, weighing but 1 lb. 1 oz., was found to contain eighteen Sprats, two Sand-Smelts, and a Cuttle-fish, with the remains of other speciesin a decomposed state. When confined in an aquarium it is necessary to supply it with living food, and in the case of those so kept at Brighton, it was observed that the Dories either waited passively until the fish provided swam sufficiently near as to be engulphed by a single snap of their highly-extensile jaws, or they approached them so slowly and stealthily by means of the scarcely-perceptible vibratory action of the two vertical fins, before referred to, that their advent was either not noticed or viewed with unconcern, until, with the rapidity of a flash of lightning, one or more victims in the shoal had disappeared within the Dory's capacious mouth.

* W. Saville Kent, "On Fish Distinguished by their Action." 'Nature,' July 31, 1873.

A length of from eighteen to twenty-two inches, with a weight of from twelve to eighteen pounds, represent the largest proportions which the John Dory attains upon our coasts. It enjoys an almost cosmopolitan distribution, extending from Norway throughout the Atlantic; and a variety of the same species, according to some authorities, is met with at the Cape of Good Hope, South Australia, and Japan.

FAMILY XIV.—SWORD-FISHES (*Xiphiidæ*).

Body compressed, naked, or with rudimentary scales; the upper jaw, comprising the ethmoid, vomerine and premaxillary bones, produced into an ensiform or sword-shaped process; teeth absent, or very minute; branchiostegal rays seven in number.

The European Sword-fish (*Xiphias gladius*), No. 53, common in the Mediterranean, where it is the subject of an important fishing industry, is not an unfrequent visitor to our own shores. It is one of the largest Acanthopterygian fishes, attaining to a length of twelve or fifteen feet and upwards, in aspect not unlike a Tunny, having superadded to it the very formidable sword-like rostrum from which it takes its name. The precise use of this structure, except as a weapon of offence, is one of the zoological problems that have yet to be solved. According to ancient tradition the fish is accustomed to use its sword for impaling the fish, upon which it feeds, like larks upon a spit; a difficulty connected with such an interpretation is, however, an explanation of the method by which after capture in such manner he detaches his prey and conveys it to his mouth. Modern writers have suggested that it uses its

rostrum for turning up the sand in search of worms and other bottom food; the fact, however, that Pilchards, Cuttles, and other pelagic forms have generally been found within the stomachs of examples that have been dissected, tends to negative this interpretation. As another alternative it might be suggested that the Sword-fish uses its weapon for securing food, as the Saw-fish (*Pristis antiquorum*) is reported to do its saw, namely, by swimming, or metaphorically running a-muck among the shoals of smaller fish, numbers of which, by vigorously applied lateral strokes of its rostrum, the Saw-fish thus disables and then devours at leisure. The irreconcilable enmity subsisting between the Sword-fish and all species of the Whale tribe is a matter of tradition, the Fox-Shark (*Alopecias*), being its reputed ally in its attacks upon the leviathan of the deep. Many instances have been recorded in which Sword-fishes have attacked moving vessels, probably mistaking their submerged hulks for their hereditary foe. In the Museum of the Royal College of Surgeons is the section of the bow of a South-Sea whaler, the solid wood of which has been transfixed by the rostrum of one of these fish to the depth of thirteen and a half inches, the weapon having luckily broken off in the hole, and so prevented what might have proved a dangerous leak. In the Buckland Museum will be found two fine casts of specimens of the Sword-fish, each measuring over eight feet in length, captured respectively at Ramsgate, and Leigh near Southend; and also the portion of a ship's side, which had been pierced, first through a sheathing of one inch thickness, next through a three-inch plank, and beyond that into four and a half inches of solid timber, by the sword of the tropical form (*Histiophorus*). It was estimated by a mechanical

engineer that it would have required nine strikes of a hammer weighing twenty five pounds to drive an iron bolt of similar shape and size to an equal depth in the same hull.

FAMILY XV.—MAIGRE FISHES (*Sciænidæ*).

Body elongate, compressed, mostly clothed with serrated scales; teeth disposed in villiform bands, sometimes with supplementary canines; the pre-operculum unarmed and without a bony stay, branchiostegal rays seven in number; air-bladder usually present, frequently with branching diverticula.

The Maigre or Sciœna (*Sciœna aquila*), No. 54, is the only member of this family that can with certainty be included among our British species, the reported capture of the Umbrina (*Umbrina cirrhosa*), on one occasion, at the mouth of the river Exe, not being accepted as trustworthy. In shape and size the Sciœna bears no slight resemblance to the Giant-Perch (*Serranus gigas*), already described; but from which and all other members of the Percoid family it may be readily distinguished, from the absence of conspicuous spines and serrations on the opercular bones. Its colours during life are, according to Couch, very brilliant. 'The general surface of the body being a rich bronze-yellow, the antero-dorsal region and head light green, the first dorsal fin brilliant pink, the remaining fins being darker with perhaps a tinge of red. After death the brilliant colouration of the body soon fades to a coppery or neutral tint, leaving the fins a more or less uniform dull red. The Sciœna is in the habit of congregating in shoals, and it has been observed that it possesses the faculty of emitting sounds, audible at the surface of the sea from a considerable

depth, such sounds having been variously compared by fishermen to bellowing, buzzing, purring, and whistling. It has been suggested that the reputed song of the Mythological Sirens took its origin from the noises emitted by shoals of this fish. The casts of two fine Sciœnæ, measuring each about five feet with a weight of eighty pounds, are on view in the Buckland Museum. A young spirit-preserved specimen will also be found among the series forming the Day Collection. Many of the exotic members of the genus Sciœna ascend the mouths of rivers into perfectly fresh water.

FAMILY XVI.—HAIRTAILS (*Trichiuridæ*).

Body elongated, much compressed, scales rudimentary or absent; the gill openings wide; teeth well developed; the dorsal and anals fins greatly elongated, many rayed; ventral fins absent or rudimentary; caudal fin sometimes wanting; branchiostegal rays seven or eight in number.

The flattened, somewhat Eel-like fishes comprised in this family are represented in British waters by two species, both of which are of rare occurrence in these latitudes, their native habitat being the warmer regions of the Atlantic. The first species, known as the Silver Hairtail (*Trichiurus lepturus*), No. 55, taking its name from the almost hair-like tenuity of its caudal termination, attains to a length of about two feet six inches, its colour, when fresh, being, as described by the late Mr. Frank Buckland, comparable to that of a new shilling or a lady's satin shoe. This silvery pigment, which invests the whole body in the form of a very delicate membrane, becomes so readily detached after death, that it is almost impossible to preserve an example representing any approach to the

aspect of the fish in its living state. An half-grown specimen of this rare type will be found among the spirit-preserved series belonging to the Day Collection, and the cast of an adult in the Buckland Museum. The second British representative of the *Trichiuridæ* is the so-called Scabbard-fish (*Lepidopus caudatus*), No. 56, a fish of much larger dimensions, attaining to a length of five or six feet or more, its body in shape being very elongated, flattened, or sword-like, and, as witnessed by the writer off the coast of Portugal, flashing when freshly taken from the water like burnished silver. In the spring months of the year, when

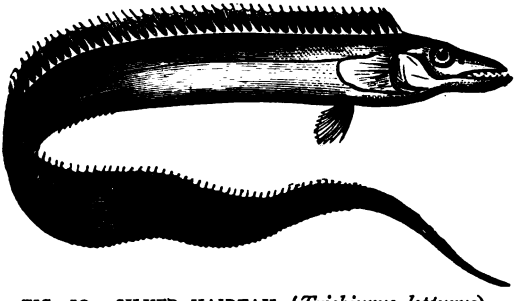

FIG. 10.—SILVER HAIRTAIL (*Trichiurus lepturus*).

it migrates from the deeper waters of the ocean towards the shore for the purpose of spawning, it is very plentiful along the coasts of southern Europe, and there constitutes an important fishery. The Scabbard-fish is distributed abundantly throughout the tropical waters of the Atlantic, and has been taken so far south as the Cape and New Zealand; examples recorded from the last-named station are, apparently, as is the case with British specimens, accidental wanderers only from warmer latitudes. A dried specimen, and also a cast of the Scabbard-fish, will be found in the Buckland Museum.

FAMILY XVII.—GOBIES (*Gobiidæ*).

Body elongate, naked or scaled; teeth usually small, sometimes including distinct canines; spinous dorsal fin or moiety of the dorsal fin the less developed, its membrane supported by simply flexible spines; the ventral fins usually (in all British species) united with each other in such a manner as to form a funnel-shaped disc; branchiostegal rays four to six in number.

The Goby family includes a very large number of small carnivorous fishes that are essentially inhabitants of the litoral zone, some of them adapting themselves to a freshwater habitat. As many as nine species are included in the British list, the largest form, known as the Black Goby or Rock Goby (*Gobius niger*), No. 59, attaining to a length of eight or nine inches, while certain of the smaller ones measure no more than one or two inches.

The Black Goby, which may be taken as the type of its family, is frequently met with beneath large stones at low water, it selecting such a habitat not only as an ordinary domicile, but as a nursery where it may safely deposit and hatch its spawn. The eggs, as frequently observed by the writer, are of a very singular shape, being elongate, ovate, or fusiform, about three times as long as broad, and are attached vertically by one of the smaller ends in a single, closely approximated layer, that may extend over an area of many square inches of the undersurface of the rock selected. Over these eggs the male fish now mounts guard, vigorously repelling all would-be intruders with whom he can cope on equal terms, and in those instances in which the disturbing influences are apparently too strong for him—such as human interference—resorting, in self-defence, to an artful stratagem. On several occasions, when shore-

collecting in the Channel Islands, the writer has, in fact, on turning the rocks over in search of specimens, dislodged what at first sight, from the apparently large size of its head, was taken for a Bullhead (*Cottus*), but which on closer examination proved to be an example of the Rock Goby, with its opercula and branchiostegal membranes abnormally distended, with the evident intention of passing itself off as one of those spiny-headed *Cottidæ*, which are not to be handled with impunity. A like imitation of a hurtful or stronger form is adopted, as a means of protection, by harmless and weaker species in many departments of the Animal Kingdom. The coalescence into a single funnel-shaped organ of the usually separated pair of ventral fins, is a very distinctive feature of the Gobies, and prepares the way for that further modification of this region, that obtains among the true Sucking-fishes, *Discoboli* and *Gobiesocidæ*. This funnel-shaped fin expansion is, indeed, utilised by the Gobies as an adherent organ or acetabulum, these fish, as may be verified by watching them in an aquarium, being able with the aid of such structure to adhere firmly to the smooth surface of the glass front of their tank. Some of the smaller Gobies are remarkable for their brilliant colouration, one in particular, the Paganellus (*Gobius paganellus*), No. 58, having its brown-mottled body relieved by the dorsal fins, which are ornamented with two broad, longitudinal bands of red and blue. This fish grows to about half the length of the Black Goby, but is relatively shorter and thicker. On the Jersey coast, at very low spring tides—the vertical rise and fall averaging at such times between forty and fifty feet—the writer has obtained a species of Goby that is yet more brilliantly coloured, and which he has not yet been able to identify precisely with either any British or Continental form

hitherto described. In form and general details it most closely resembles the Two-spotted Goby (*Gobius Ruthensparri*), No. 59, and, like it, has a dark spot or ocellus on each side, both at the base of the tail and near the axilla of the pectoral fin. The proportions of all the fins are, however, much larger, and the second dorsal and anal ones in particular have their hinder rays so much prolonged as to reach nearly to the base of the tail. In life the two long dorsal fins have each three narrow, sub-parallel, bright crimson longitudinal bands on a pale blue ground; about fourteen or fifteen conspicuous bright emerald-green spots are developed at somewhat irregular distances along the lateral line, the remaining surface of the body being variegated with various shades of brown, grey, and yellow. Possibly this form is identical with Couch's (*Gobius bi-ocellatus*), which Dr. Day, "British Fishes," proposes to unite with *G. ruthensparri*, but it is certainly distinct from the type specimens of the last-named form contained in the Day Collection, and the colouration, here described from living examples, though possibly assumed only at the breeding season, has not been recorded of any other species. The remaining British members of the Goby family are the One-spotted Goby (*Gobius minutus*), No. 60; the Speckled Goby (*G. parnelli*), No. 61; the Painted Goby (*G. pictus*), No. 62; the Four-spotted Goby (*G. quadrimaculatus*), No. 63; the Transparent Goby (*Aphia pellucida*), No. 64; and Nilsson's Goby (*Crystallogobius Nilssonii*), No. 65.

FAMILY XVIII.—DRAGONETS (*Callionymidæ*).

Body elongate, usually somewhat depressed, the pre-operculum without a bony stay; teeth not developed on the palate, only in the jaws; dorsal fins two in number, the

anterior one often abnormally prolonged—its membrane supported with from four to seven flexible spines; branchiostegal rays, five or six in number; air-bladder absent.

The Dragonets, classed with the Gobies by some authorities, but differing from them in the normal, separated condition of their ventral fins, are distinguished by the same litoral habits, one species, the gemmeous Dragonet or Yellow Skulpin (*Callionymus lyra*), No. 66, being not uncommon on the flat, sandy shores of the south-east coast. The male is remarkable not only for its brilliant colouration but also for the extraordinary development of the anterior

FIG. 11.—DRAGONET (*Callionymus lyra*).

dorsal fin, the first ray of which in the adult fish reaches, when folded back, from its origin a little behind the head to the base of the tail, the fin when erected bearing no slight resemblance to the narrow lateen sail of an Oriental fishing-yawl. The colour of the body in the same fish is orange or yellowish, diversified with numerous longitudinal stripes, spots and markings of blue and lilac, a similar variegation extending to the dorsal fins. At the breeding season these colours are yet more highly intensified, the darker shades developing to deep ultramarine and violet, reflecting a metallic sheen. The female, which is dressed in paler tints of russet-brown, and is devoid of the prolonged dorsal fin

which characterises the male, was originally described as a distinct species, under the title of the Dusky Skulpin (*Callionymus dracunculus*), and it is interesting to find that the male, in its immature condition, agrees in form and colour with the adult female. The phenomena attending the spawning operations of the Dragonet, as witnessed by the writer of examples confined in the tanks of various aquaria, are very remarkable, and were briefly referred to by him in 'Nature' of July 30, 1873. At such times, the male, resplendent in his bridal livery, swims leisurely round the female, who is reclining quietly on the sand, his opercula abnormally distended, his glittering dorsal fin erect, and his every effort being concentrated upon the endeavour to attract the attention and fascinate the affections of his chosen mate, much after that manner of courting commonly pursued by the male birds of the Pheasant family and other Gallinaceæ usually termed "shewing." The female, at first indifferent, becomes at length evidently dazzled by his resplendent attire and the persistency of his wooing, she rises to meet him, the pair—so far as such a course is practicable with fishes—rush into each other's arms, and, with their ventral areas closely applied, ascend perpendicularly towards the surface of the water. In connection with these manœuvres, it may be safely predicated that the ova are extruded and fertilised, but in the limited depth of water of an aquarium tank, the matrimonial tour cannot, apparently, be sufficiently prolonged to assure the consummation of this act; the fish after reaching the surface being projected by their previously gained impetus slightly above the water, when, falling apart, they sink slowly to the bottom, and the process after short intervals is repeated. It is, however, by no means impossible nor even improbable that the fertilisation of the eggs in Callionymus may take

place while the fish are projected above the surface of the water, as has been actually recorded by Alexander Stenzel, of Tankow, of the freshwater Continental "Nase" or "Zupe" (*Chondrostona nasus*). A fine pair, male and female, of gemmeous Dragonets will be found mounted side by side in the spirit series forming the Day Collection. Unfortunately no method yet attempted has resulted in the successful preservation of the colours as in life of the male. A second more southern form, the Spotted Dragonet (*Callionymus maculata*), No. 67, has on one occasion been taken off the British coast.

FAMILY XIX.—LUMPSUCKERS (*Discoboli*).

Body inflated, transversely expanded or oblong, naked or tuberculated; teeth minute; the gill openings narrow; one or two dorsal fins; the ventral fins, each with one spine and five rudimentary rays, the pair being so united by membrane as to form a round, strongly adhesive suctorial disc or acetabulum; branchiostegal rays five or six in number; air-bladder absent.

The Lump-fish, Lumpsucker, Sea-Owl, Sea-Hen, or Cock-and-Hen-Paddle, as it is variously named (*Cyclopterus lumpus*), No. 68, is one of the most grotesque-looking of our British fishes. Its inflated, ungainly body, peculiar semi-transparent consistence, and tubercular armature, conduce to impress a stranger that he has before him some quaint organism from the waters of China and Japan, in the composition of which, as not infrequently happens, nature has been materially assisted by human intervention. The efficient adhesive organ or sucking disc, modified from the ventral fins developed on the under surface, completes the sum of its peculiarities, and provides the fish with an efficient

grapnel wherewith the animal, naturally a weak, clumsy swimmer, can, as it were, lay to in a storm, or ride securely anchored within the swirl of the strongest current. The young of the Lump-fish or Sea-Hen, which may be appropriately named Sea-Chickens, are, in the living state, even more remarkable in appearance than the adults, they being much more transparent and of a bright sea-green hue, as though modelled in green glass or beryl. In marine aquaria, where they are usually exhibited during the spring months of the year, they form most attractive objects, swimming fearlessly in the water, or coming to

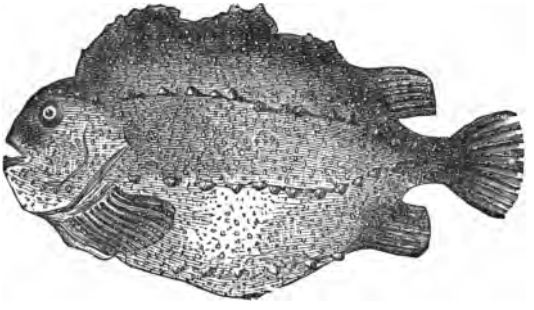

FIG. 12.—LUMP-FISH (*Cyclopterus lumpus*).

anchor on the glass-work of their tank, and manifesting apparently a strong predilection for a game of hide-and-seek with the visitors from behind the supporting mullions. In this position one or more specimens are usually to be detected, through the sudden apparition of a comical green head with goggle eyes, or the momentary flourish of a little stumpy tail. In another minute, perhaps, one little fellow, finding himself an object of admiration, takes "heart of grace," shuffles forward for a few inches along the glass, still adhering by his sucker, and thus permits an unobstructed view of his entire organisation. These Lump-

fish, young and old, feed voraciously on live shrimps, the "chickens" exhibiting extraordinary precocity in the chase and capture of these Crustacea. Any one of them will rush after and attack a Shrimp as long or longer than himself; generally, too, he contrives to master it, and with much puffing and panting, and many a struggle to swallow it whole, with the exception perhaps of the long horns or antennæ, which will not go down, but are left ludicrously projecting from the little glutton's mouth. Such indeed is the greediness of these youthful Lump-fish, that if allowed this crustaceous diet without discretion they literally gorge themselves to death. The Lump-fish is not only the largest representative of its tribe, but, as compared with other forms, attains to a considerable size. Examples measuring in length from twenty inches to two feet, and with a weight of from twelve to fifteen pounds, are not infrequent. Several admirable casts of such fine adult specimens will be found in the Buckland Museum, the most interesting illustration being, however, included in the Day Collection, where in the jar No. 68 *a-e* is exhibited a series ranging from a length of half an inch only to six inches, or about one third the size of the adult fish. It is interesting to observe that in the younger stages a membraneous first dorsal fin is distinctly developed; but, as growth progresses, this becomes gradually imbedded within, and finally entirely obliterated by an outgrowth of the rough skin of the dorsal surface. The periodical arrival of the Lump-fishes upon our coasts during the earlier spring months is for the purpose of spawning. The eggs, deposited in a large mass among fissures of the rocks, are bright salmon-colour, and otherwise much resemble in size and aspect masses of dryly-boiled sago. Mr. Frank Buckland ascertained that the roe of a female fish weighing eleven pounds contained no less

than 194,112 eggs. These, after deposition, are jealously guarded by the male, who will not hesitate even to attack so formidable an antagonist as the Wolf-fish (*Anarrhicas lupus*) in defence of his prospective progeny. The remaining British representatives of the family *Discoboli* are the two small smooth-skinned fishes, the Sea-Snail or Unctuous-Sucker (*Liparis vulgaris*), No. 69, and the Montagu's or Network-Sucker (*Liparis Montagui*), No. 70. Examples of these varieties, which rarely attain to a greater length than from three to six inches, will be found among the spirit series forming the Day Collection.

FAMILY XX.—FLATHEADED SUCKERS (*Gobiesocidæ*).

Body elongate, depressed anteriorly, devoid of scales; teeth conical or compressed; a single spineless dorsal fin, developed towards the caudal region of the body; ventral fins widely separated, having developed between them an adhesive apparatus whose periphery is limited anteriorly by these fins but posteriorly by a cartilaginous expansion of the coracoid bones; branchiostegal rays five or six in number.

The family of the *Gobiesocidæ* is represented in British waters by three or four species only, belonging to the genus *Lepidogaster*. All are of small size, rarely exceeding two or three inches in length, and are for the most part inhabitants of the litoral zone, being abundantly met with under stones in the rock-pools left by the receding tide. All of them are noted for their brilliant colouring, which often varies considerably among individuals of the same species, though even here there are certain distinctive markings generally to be found. Thus in the Cornish Sucker (*Lepidogaster gouanii*), No. 71, two

large dark blue ocelli are constantly developed on the top of the head immediately behind the eyes. In the Connemara Sucker (*L. decandolii*), No. 72, two or three posteriorly converging brilliant scarlet lines ornament the sides of the head, while in the third form, known as the Bimaculated or Doubly-spotted Sucker (*L. bimaculatus*), No. 73, two dark ocelli are developed on the sides of the body, just behind the distal termination of the pectoral fins. During several years residence in the Channel Islands the writer has become acquainted with what will probably have to be regarded as a fourth British species of the genus *Lepidogaster*, but which, by Couch and other writers, has apparently been overlooked as a variety only of *L. bimaculatus*. While exhibiting manifold variations in the general ground colour of its body, which may be represented by different shades of red, green, or brown, the two lateral ocelli, distinctive of the last-named type, are never found; but in lieu of this a single, very conspicuous dark-coloured streak is developed along each side of the head, the eye being stationed immediately in its centre and interrupting it at this point. Additionally to these distinctive markings, important structural differences are found to exist in the composition of the dorsal, anal, and caudal fins, and more especially in that of the ventral acetabulum. Finally it is found to affect a different habitat, for while *L. bimaculatus* is to be obtained only with the aid of the dredge at some little distance from the shore, the form here introduced is a strictly litoral species, obtainable beneath stones in the rock-pools at all ordinary ebb-tides. This distinction in the habitats of the spotted and so-called unspotted varieties of the last-named type is alluded to in Couch's "British Fishes," as important evidence in support of the probable specific distinctness of the unspotted form.

Being unable also to identify it with any of the various non-British Continental members of the same genus, the writer has proposed provisionally to distinguish this apparently new type by the title of Couch's Sucker (*Lepidogaster couchii*), No. 73. While most plentiful on the shores of Jersey and Guernsey, this little fish is tolerably abundant also on the Devonshire and Cornish coasts. All of the flat-headed Suckers are most interesting additions to small aquaria, they speedily becoming so tame as to feed fearlessly from the hand, and their bright colours and lively habits adding greatly to their attractiveness. They breed freely in captivity, a favourite nidus for the deposition of their ova being the empty shells of bivalve molluscs. The males, as in the case of the Lump-fish (*Cyclopterus*), mount guard over the eggs till hatched.

FAMILY XXI.—BLENNIES (*Blenniidæ*).

Body elongate, compressed, naked, or clothed with minute scales; teeth well developed, diversely modified; a single dorsal fin usually extending throughout the entire length of the dorsal region, the boundary between its spinous and soft portions being indistinct or indicated by a simple notch; ventral fins composed of but few rays, often rudimentary or absent; branchiostegal rays five to seven in number; air-bladder absent.

The majority of the members of the Blenny family are small litoral fish, distributed abundantly throughout the temperate and tropical seas, and represented by as many as eight British species. Among these there occurs an exceptional type inhabiting deeper water, which, compared with its congeners, is a perfect monster. This is the well-known Wolf or Cat-fish (*Anarrhicus lupus*), No. 74, the first popular

appellation bearing reference to its ferocious disposition, and the second to the somewhat cat-like form of its large, rounded head. In the adult state the Wolf-fish attains to a length of as much as five or six feet or more. The most striking structural feature concerning this species is the complex armature of its mouth, a series of long, conical, canine-like teeth, being developed anteriorly, shorter, pointed, tubercular teeth at the sides, and a median band of massive, flattened crushing teeth, functioning as molars, occupying the centre of the palate. As might be anticipated from its formidable dental formula, just described, the food of this species consists essentially of hard-shelled organisms such as Molluscs, Crustacea, and Echinoderms, crushed remains of each of which zoological groups will be abundantly found among the stomach contents of freshly caught specimens. For the capture of such prey, and more especially for the detachment from submarine rocks of strongly adherent Molluscs and Echini, and for the subsequent trituration of their hard shells the prehensile canines and massive palatal teeth are respectively eminently adapted.

In common with other members of the Blenny family the Wolf-fish is unusually pugnacious, turning savagely upon its assailants, and capable with the aid of its trenchant teeth of inflicting exceedingly severe wounds. For this reason it is customary with fishermen, on capturing this fish, to knock out its front teeth, and to dispatch it as soon as possible. An instance is recorded of an example caught by some North Sea trawlers, which seized a mop handle that was held out to it so savagely and pertinaciously that it allowed itself to be swung overboard before it would release its hold, and one of its teeth being even then left embedded in the wood. Living examples of this very formidable and somewhat

repulsive-looking type were imported by the writer, through Messrs. Jeffs and Blake, of Gt. Grimsby, from the North Sea to the tanks of the Manchester Aquarium. Its habits, as there observed in confinement, were found to be essentially nocturnal, the fish remaining perfectly quiescent throughout the day on the shingle at the bottom of their tank, but arousing from their lethargy and swimming about in search of food on the approach of night. Preserved specimens and also several casts of fine examples of the Wolf-fish are on view in the Buckland Museum.

Among the typical Blennies, considerably resembling the

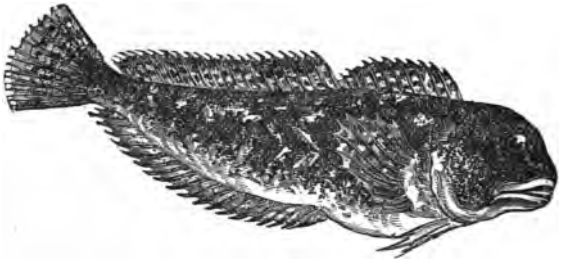

FIG. 13.—SMOOTH BLENNY (*Blennius pholis*).

Wolf-fish in shape, but of relatively pigmy proportions, are the Gattoruginous Blenny (*Blennius gattorugien*), No. 75, eight or nine inches long, having two curious antennæ-like tufts on the top of its head; Montagu's Blenny (*Blennius galerita*), No. 76, two or three inches long, with a single head tuft; the Butterfly Blenny (*Blennius ocellaris*), No. 77, length six or seven inches, and so-called with reference to the elevated, wing-like contour of, and eye-like spot devoloped upon, the dorsal fin, and lastly, the Shanny, or Smooth Blenny (*Blennius pholis*), No. 78, whose dimensions nearly accord with those of the last-named fish. Examples of each of these types will be found

among the spirit-preserved series in the Day Collection. The Smooth Blenny, which is the commonest of all these forms, occurs abundantly in rock-pools between tide-marks all around our coasts, and is remarkable as a species that will voluntarily leave the water in the pools and bask on the rocks in the sunshine, hurriedly tumbling or scrambling into its native element again on the sound of approaching footsteps, or other cause of alarm. The spawning habits of this fish, as witnessed by the writer in connection with examples acclimatised in the Manchester Aquarium, proved highly interesting, certain of the phenomena observed demonstrating the possession by the male, at least, of an amount of attachment and sagacity rarely if ever previously recorded of fish life. In a tank containing some forty or fifty examples of this Blenny, a pair had selected a narrow ledge, high up on one side, for the purpose of a nursery. The eggs were deposited in a single layer upon the ledge, first by one and subsequently by a second female, the species being thus shown to be polygamous. The male had meanwhile undergone a wonderful colour transformation, much after the manner of the male of the Black Bream (*Cantharus lineatus*), previously described. All the gay mottlings of yellow and brown that usually characterise the species had given way to a uniform tint of deep sooty black, the large, prominent lips alone remaining nearly white, his appearance under such circumstances being particularly ferocious and forbidding. Thus attired he now mounted guard over the female fish and eggs, his self-appointed task, as presently seen, proving no sinecure. The discovery was soon made, in fact, by the other members of the community, that Blennies' eggs were a choice gastronomic delicacy, and thenceforward our little friend was scarcely allowed an interval of peace. While one fish was being repulsed in front, another descended upon

and made off with the coveted booty in the rear; or, as frequently happened, there was a concerted attack along his lines of more than half-a-dozen fish. Thus overpowered by numbers, there was but little chance of a young family descending from the rocky fortress, and, indeed, several times within the course of an entire month spent by the little Blenny in the arduous endeavour to guard his embryo brood, the little aerie was mercilessly stripped of every egg. At the end of that period an untimely end befel our little hero; wearied out with his exertions he was at length unable to cope with the odds arrayed against him, and was found one morning literally torn to pieces at the foot of the ledge he had so long defended, a huge fellow, nearly twice his size, and who had doubtless been chiefly instrumental in bringing about his overthrow, now occupying the post of honour. One other little episode concerning the object of this notice remains to be chronicled: While the female was depositing her spawn, an operation which extended over several days, her brave little partner was seen on several occasions to descend to the bottom of the tank, and hurriedly snatching up a fragment of the food supplied for the general weal, to return with it aloft and place it at the disposal of his lady-love.

The remaining members of the family *Blennidæ* include Yarrell's Blenny (*Carilophus ascani*), No. 79, a rare form, somewhat resembling (*Blennius gattorugine*), examples of which are among the desiderata of the Buckland and Day Collections; the Spotted Gunnell, or Butter-fish (*Centronotus gunnellus*), No. 80, an elongate, much compressed Eel-like form, attaining a length of ten or eleven inches, and the Viviparous Blenny, or Eel-pout (*Zoarces viviparus*), No. 81, remarkable as representing the only undoubtedly viviparous British Acanthopterygian fish. The young when born are

about an inch and a quarter long, and from 200 to 300 are usually found within an adult female fish. Large adult examples of this species measure as much as two feet, but a length of about one foot or fifteen inches represents the more ordinary size. The still larger dimensions of from two to three feet long, is said to be attained by an allied American species, *Zoarces anguillaris*.

FAMILY XXII.—BAND-FISHES (*Cepolidæ*).

Body very elongate, compressed, clothed with minute cycloid scales; teeth moderate in size, pointed; preoperculum without a bony stay; dorsal and anal fins very long, more or less continuous with the caudal fin; branchiostegal rays six in number.

The Red Band-fish, or Red Snake-fish (*Cepola rubescens*), No. 82, an elongate form with an attenuate tail not unlike that of *Trichiurus*, is the only British representative of this small family group. Although generally regarded as a rare fish, few winters pass without one or more specimens being washed up by the storms upon our shores, from the deeper waters which they normally inhabit. Its colours when living are very attractive, the ground hue being bright red or even carmine, intermixed with yellow, and the fins being more or less tinged with rose-colour. A length of twenty-two inches represents the longest recorded British example. It is a common form in the Mediterranean. A preserved specimen, captured at Exmouth, is included in the Day Collection.

FAMILY XXIII.—RIBBON-FISHES (*Trachypteridæ*).

Body elongate, compressed, riband-shaped, devoid of scales; dorsal fin extending the whole length of the body; anal fin entirely wanting; caudal fin absent, or if present, rudimentary, and developed at an angle diverging from the normal longitudinal axis; branchiostegal rays six in number.

The Ribbon-fishes, represented by two British species, the Deal-fish, or Vaagmaer (*Trachypterus arcticus*), No. 83, and Bank's Oar-fish, or Ribbon-fish (*Regalecus Banksii*), No. 84, are rare forms, inhabiting the deeper, colder waters of the ocean, diseased or disabled specimens only being at long intervals found floating helplessly on the surface or cast upon our shores. Both species are remarkable for the relative thinness of their compressed bodies, whence their name of Ribbon-fishes. Bank's Oar-fish, more especially, attaining to a length of from sixteen to twenty feet, yields no more than from two to three inches as its greatest thickness. Casts of a fine example of this species, captured at Dunnett Bay, Caithness, in July, 1877, as also of a shorter specimen from the Mediterranean, will be found in the Buckland Museum. In both instances, unfortunately, the very slender, oar-like pectoral fins and crest-like elevated rays at the commencement of the dorsal fin had been removed or lost at the time of capture. The development of these elongated appendages would appear to vary at different ages, and probably in connection with the separate sexes. The fish known as Hawkin's Gymnetrus, figured erroneously in Buckland's "British Fishes" as possessing a large fan-shaped tail—the caudal region was actually wanting in the type when stranded near Penzance—and four pedunculated, paddle-shaped ventral rays, is now generally regarded as

an imperfectly observed example only of *Regalecus Banksii*. It is by no means improbable that many of the tales concerning the existence of the Sea-Serpent have originated in connection with these Ribbon-fishes, and which, swimming along the surface of smooth water, would create an undulating wave behind them, which would add apparently very considerably to their actual length.

FAMILY XXIV.—SAND-SMELTS (*Atherinidæ*).

Body more or less elongate, sub-cylindrical, clothed with cycloid scales; teeth minute; dorsal fins two in number, the first armed with feeble spines; branchiostegal rays five or six in number; air-bladder present.

The Sand-Smelts are small, gregarious fishes, rarely exceeding a length of six or seven inches, distributed throughout the temperate and tropical seas, one form, the common Sand-Smelt, or Atherine (*Atherina presbyter*), No. 85, being exceedingly abundant upon the south coast of England. It must not be mistaken for the true Smelt (*Osmerus eperlanus*), one of the *Salmonidæ*, whose family affinities will be at once recognised by its possession of the characteristic functionless or adipose posterior dorsal fin. A reputed second but much rarer British Sand-Smelt is Boyer's Atherine (*Atherina Boyeri*), No. 86, more usually inhabiting the Mediterranean and the Atlantic as far south as Madeira, but which is reported to have been taken on one or two occasions upon the Cornish coast. The first-named, commoner species, is much esteemed as an article of food.

FAMILY XXV.—GREY MULLETS (*Mugilidæ*).

Body more or less oblong and compressed, clothed with cycloid or ctenoid scales; cleft of the mouth narrow, teeth absent, or feebly developed; dorsal fins two in number, the anterior one composed of four strong spines; branchiostegal rays five or six in number; air-bladder large.

The Grey Mullets are gregarious, shore-frequenting fishes, which not infrequently ascend the mouths of rivers into brackish and even fresh water. All the species are much esteemed for the table, two of them, the common or thin-lipped Grey Mullet (*Mugil capito*), No. 87, and the Lesser or Thick-lipped variety (*Mugil chelo*), No. 88, being abundant on the British coasts. When fished for and enclosed by nets, Grey Mullets display much ingenuity in their endeavours to avoid capture, one or more of the number often making its escape by leaping over the corked border of the net into the open sea again, and the whole shoal quickly following suit at the same point like a flock of sheep over a meadow fence. Being acquainted with the proclivities of these Mullets, the Levant and other Mediterranean fishermen take the precaution to extend extra netting above the surface of the water, from pieces of cane fastened perpendicularly to the cork line—the escape of the fish in the manner above described being thus effectually debarred. Fine examples of the larger or common Grey Mullet attain to as great a length as two or three feet; all the species closely resemble each other in colour, their ground tint being a silvery grey, variegated by from six to eight darker steel-blue longitudinal lines along the sides, the head and cheeks usually reflecting a bronze or golden tint. Grey Mullets become remarkably tame when acclimatised in aquaria; examples introduced by the writer to the

Manchester tanks were accustomed to take their food quite leisurely from their keeper's hand. The entire absence of cirrhose appendages or barbels upon the lower jaw readily distinguish the Grey Mullets from the members of the true Mullets or Surmullets, family *Mullidæ*, previously described.

FAMILY XXVI.—STICKLEBACKS (*Gasterosteidæ*).

Body elongated, compressed, scaleless, but more or less protected by bony scutes; the mouth cleft oblique; teeth villiform, opercular bones unarmed; the first dorsal fins composed of isolated spines, ventral fins articulated with

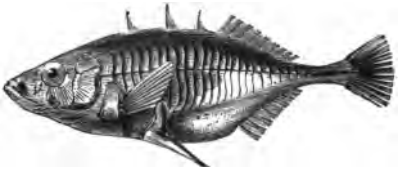

FIG. 14.—THREE-SPINED STICKLEBACK (*Gasterosteus aculeatus*).

the pubic bones, each consisting usually of one spine and one soft ray; branchiostegal rays three in number; air-bladder present.

The Stickleback family includes some half-a-dozen known species of small-sized fish, distributed throughout the Arctic and Temperate regions of the northern hemisphere. All of these are referable to the same genus (*Gasterosteus*), and are, with one exception, naturally inhabitants of fresh water, but at the same time susceptible of acclimatisation in brackish and even salt water. Of the three British species the commonest and most familiar type is the three-spined Stickleback (*Gasterosteus aculeatus*), No. 89, abundant in almost every canal, pond, or stream in the

neighbourhood of our larger cities. Under its various local names of the "Tittler," "Tittlebat," and Jack Sharp, it there, not infrequently, first awakens and stimulates into activity among the youthful population that passion for distinction in the art of angling, which in after years yields more substantial fruit in the form of many a distinguished votary of that gentle craft, of which the famous Sir Isaac Walton was at once the founder and high priest. The nest-building habits of the Sticklebacks, including both the marine and freshwater species, are well known and of great interest, and may be easily observed of examples kept in confinement. The task of building the nest devolves upon the male fish, who at the breeding season—usually the spring or early summer—assumes as his nuptial attire, in the case of the present species, *G. aculeatus*, the most gorgeous tints of scarlet, green, and silver.

The nest itself is composed of fine vegetable fibres, matted together into an irregular spheroidal mass, having a hollow centre and a round hole at the top. His work completed he now sallies out, and after the apparent exercise of much persuasive eloquence, induces first one and subsequently several female fish to return with him and deposit their eggs within the little arbour. Over the nest with its enclosed treasures, and, indeed, over a considerable area surrounding it, he now mounts guard, and vigorously repels the too close approach of either a comrade of his own species or any other fish. It not infrequently happens that two individuals select such contiguous spots for their nests, that there is a constant trespass on one side within the magic circle over which the other fish would exercise a monopoly. This gives rise to implacable hostilities between the rival claimants, which are usually prosecuted with such vigour, that the weaker of the two is either slain, being

literally ripped open by the ventral spines of his opponent, or is driven ignominiously from the field. It has been observed that the victor in these combats immediately acquires a far more brilliant hue than he previously possessed, with an augmented display of activity and defiance in his bearing. The vanquished, on the other hand, if he escapes with his life, loses all his gay tints, and retires into obscurity among the females and more peaceable members of the shoal.

The Three-spined Stickleback is remarkable for the great number of sports or varieties into which it developes in different localities, and in accordance with the nature of its surroundings. Such varieties are manifested chiefly in connection with the protective armature of vertical bony plates developed along the sides of the body; those affecting a salt-water habitat, and thus being exposed to a greater number of enemies, being the most completely armed, and those confined to quiet inland waters being the least protected in this respect. Dr. Day, in his 'Fishes of Great Britain,' enumerates, in addition to the normal form, as many as six such local varieties of this type, the majority of which will be found in the spirit-preserved collection that bears his name. These include the Rough-tailed Stickleback (*G. trachiurus*), with from thirty to forty plates each side, the Half-encuirassed Stickleback (*G. semiloricatus*), with twenty-two or twenty-three vertical plates, the Half-armed variety (*G. semiarmatus*), with ten to fifteen such plates, and the Quarter-armed or Smooth-tailed Stickleback (*G. gymnurus*), with from four to six shields only. The two remaining varieties are the Short-spined form (*G. brachycentrus*), with very short dorsal and ventral spines, and the so-called Four-spined Stickleback (*G. spinulosa*), with a rudimentary fourth dorsal spine developed between the two hindmost spines

of the normal type. These several varieties have been regarded as separate species by many writers, but since every gradation between them may be successfully traced, they evidently possess no sound claim for such distinction. A length of three and a half inches represents the largest dimensions recorded of British examples of *G. aculeatus*. A second undoubted freshwater indigenous species is the so-called Tinker or Ten-spined Stickleback (*Gasterosteus pungitius*), No. 90, which takes its first name from the almost black tint it usually assumes in the breeding season, and its second one with reference to the number of spines which usually occupy the position of the ordinary first dorsal fin. It is the smallest British freshwater fish, it but rarely exceeding two inches in length. In habits it closely resembles the three-spined species, and in some localities is the more abundant of the two. The third British species, known as the Sea or Fifteen-spined Stickleback (*Gasterostius spinachia*), No. 91, is an essentially marine form that occasionally ascends rivers into brackish water. With reference to its somewhat snake-like contour it is known in some localities as the "Sea-Adder," a title, however, which is more commonly applied to the Pipe-fishes (*Syngnathidæ*). From five to six inches represents the length to which it most ordinarily attains.

FAMILY XXVII.—TRUMPET-FISHES (*Centriscidæ*).

Body oblong, or elevated and compressed, covered with minute scales, or protected by a cuirass of non-confluent ossifications; the anterior bones of the skull forming an elongated tube with a small terminal, toothless mouth; dorsal fins two in number, the first one containing a single,

abnormally developed spine; branchiostegal rays three or four in number; air-bladder large.

The Trumpet or Bellows-fish (*Centriscus scolopax*), No. 92, a small compressed form, not altogether unlike the Boar-fish (*Capros aper*), but distinguished from that form by its elongated snout and single, long dorsal spine, is the only member of this small family that has been taken, and then on very rare occasions, in British waters. In common with a few other allied forms it is an essentially sub-tropical type, finding its home in the warmer waters of the Mediterranean and more southern seas, stray wanderers only reaching these latitudes accidentally. An illustrative example of this singular species is still a desideratum for the Buckland Museum.

FAMILY XXVIII.—WRASSES (*Labridæ*).

Body oblong or elongated, clothed with cycloid scales; the lips often highly protrusile; teeth absent from the palate, elsewhere well developed; dorsal fin single, the spinous portion as long or longer than the soft; branchiostegal rays five or six in number; air-bladder present.

The family of the Wrasses, or Rock-fishes, as they are sometimes called, includes a large number of litoral rock-frequenting fishes, abundantly distributed throughout the temperate and tropical zones, seven or eight species frequenting the British seas. A structural peculiarity that specially distinguishes many of these fishes, and whence they derive their technical name of *Labridæ*, or Lipped-fishes (from *labrum*, a lip), is connected with the formation of their lips, which are very large, fleshy, prehensile, and so folded as to permit of their protrusion to some distance beyond the oral aperture. The family, as a whole, is

further remarkable for the brilliant colouration of its component members, many of the British species in common with their allies—the Parrot-fishes of the tropical seas—having to be reckoned amongst the most gorgeously tinted examples of the entire fish series. In this connection it is further found that the two sexes are often so differently coloured as to have been for a long time regarded as separate species, while in other instances, again, it is difficult to find two individuals of the same form that correspond precisely with one another in the hue and pattern of their markings. The Spotted, or Ballan Wrass (*Labrus maculatus*), No. 93, is our commonest and largest indigenous type,

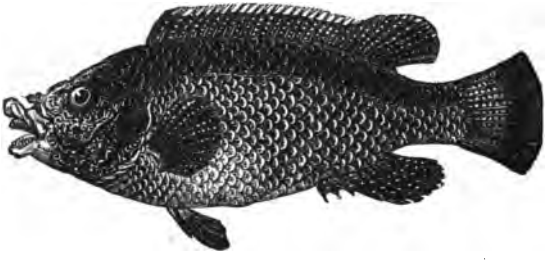

FIG. 15.—BALLAN WRASS (*Labrus maculatus*).

adult examples often measuring from fifteen to eighteen inches in their total length. The ground colour of this fish may run through various shades of brown, blue, green, or yellow, diversified usually by reticulations on the cheeks and anterior regions of brilliant red, similar coloured spots and other lines and markings being developed over the remaining surface of the body. The bright grass-green variety of the Ballan Wrass shading off to yellow on the abdomen, and with yellow streaks along the sides, was formerly named by Couch, the Green-streaked Wrass (*Labrus lineatus*); and another form, the Comber, or Dunovan's Wrass (*Labrus Dunovani*). A yet more brilliantly coloured

species is the Cuckoo, or Blue-striped Wrass (*Labrus mixtus*), No. 94, the male of which, in the adult state, has numerous irregular broad bands and markings of the richest cobalt-blue, distributed upon a general ground colour of orange or paler yellow, these colours during the breeding season becoming greatly intensified, and usually supplemented by an opaque whitish or pale green patch on the top of the head and dorsal region. The female, for a long time regarded as a distinct species, and known by the title of the Three-spotted Wrass (*Labrus trimaculatus*), has an orange-red ground colour, variegated only by the presence of three conspicuous black spots, with intervening white patches on the dorsal region in the neighbourhood of the tail. It is a remarkable fact that the young males are similarly coloured, but gradually develope the blue lines, patches, and other markings of the adult fish as they advance towards maturity. The Corkwing, or Baillon's Wrass (*Crenilabrus melops*), No. 95, a smaller species, rarely exceeding six inches in length, somewhat resembles young examples of *Labrus maculatus*, its normal ground colour being green, with bright scarlet and blue reticulations ; but it is to be distinguished from that form by the usual presence of seven or eight obscure vertical bands upon the sides of the body, and a single darker spot close to the base of the caudal fin. Jago's Goldsinny (*Ctenolabrus rupestris*), No. 96, has likewise a black spot at the root of the tail, but the ground colour is a rich golden-brown. In the Small-mouthed Wrass, or Rock-cook (*Centrolabrus exoletus*), No. 97, the male fish is resplendent with brilliant violet stripes and markings. Two remaining members of the Wrass family that occur very rarely on the British coasts, are the Scale-rayed Wrass (*Acantholabrus palloni*), No. 97, and the Rainbow-Wrass (*Coris julis*), No. 99, which is a

common form in the Mediterranean. The majority of the preceding types will be found well represented in the preserved series forming the Day Collection. Unfortunately no method has yet been discovered of preserving their vivid colours as in life. Visitors to the Exhibition will, nevertheless, have an opportunity of verifying the descriptions given of these Wrasses, by an examination of the living examples of various species that have been already introduced into tanks of the Aquarium in the West Arcade. A highly interesting fact connected with the Wrasses, is their habit of moving about only by daylight, and of repairing to the rocks to sleep at night. On taking a lantern to their tanks after dark, they will be found in various recumbent positions on the ledges or on the crannies of the rockwork, and are so lethargic that they may be handled. Grey Mullets likewise sleep at night, but floating at the surface of the water.

ORDER. II.—SOFT-FINNED FISHES (*Anacanthini*).

Vertical and ventral fins, without spinous rays; the ventral fins, if present, jugular or thoracic. Air-bladder, when developed, without a pneumatic duct.

FAMILY I.—COD TRIBE (*Gadidæ*).

Body more or less elongated, covered with small cycloid scales; the gill openings wide; dorsal fins one, two, or three in number, occupying nearly the whole length of the back; one or two anal fins; the caudal fins free, or united with both the last dorsal and anal fins; bran-

chiostegal rays seven or eight in number; an air-bladder usually present; one or more cirrhose appendages, barbels frequently developed from the chin or upper lip.

The Cod family, restricted in its distribution to the colder waters of the Temperate and Arctic seas, represents one of, if not quite the most commercially important group included within the fish fauna of the world, and since in such connection it will receive especial attention in the Handbooks devoted to Food Fishes and Sea-Fishing, an enumeration is simply here given of the large number of forms that frequent British waters. The well-known Cod (*Gadus morhua*), No. 100, which occupies the head of the list with respect to size, abundance, and general utility, is remarkable

FIG. 16.—LING (*Molva vulgaris*).

for developing several very distinct local varieties, which, with a certain class of zoologists, have been admitted to the rank of separate species. The so-called "Lord-fish" is one of these in which a greater or less number of the caudal vertebræ having coalesced together, the head is relatively very long, and in reference to which peculiarity it formerly received the title of *Gadus macrocephalus*. In the so-called Speckled-Cod (*Gadus punctatus*), of Fleming, numerous black dots are thickly developed over the dorsal surface, which have been shown by Dr. Day to be due to the presence of a parasitic organism. While the "Red Cod" is a variety inhabiting the deeper waters of the ocean, and apparently owing the colour from whence it derives its name to its dietary, which is said to consist almost entirely of

young Lobsters and Star-fish. The largest recorded example of the Common Cod, captured on our coasts, would appear to be the fish weighing seventy-eight pounds, and measuring five feet eight inches, taken at Scarborough in the year 1755, and said, on Pennant's authority, to have been sold for the modest sum of one shilling. The Haddock (*Gadus æglefinus*), No. 101; the Whiting Pout, Rock Whiting, or Bib (*G. luscus*), No. 102; the Silver Whiting (*G. merlangus*), No. 104; the Green Pollock, Coal-fish or Saithe (*G. virens*), No. 106; the Common Pollock (*G. pollachius*), No. 107; the Hake (*Merlucius vulgaris*), No. 108; and the Ling (*Molva vulgaris*), No. 110, are all familiar examples of the Cod family of high economic value. In addition to these there are several forms which are not sufficiently abundant, or do not attain to a sufficient size, to be of commercial importance. The Power-Cod (*Gadus minutus*), No. 103; and the various species of Rocklings (*Motella mustela*), No. 112; (*M. cimbria*), No. 113; (*M. tricirrhata*), No. 114; and (*M. macrophthalma*), No. 115, belong to this series, as also do the Lesser Fork-head or Tadpole-fish (*Raniceps raninus*), No. 116; and the Greater Fork-beard or Torsk (*Brosmius brosme*), No. 117. The most interesting form of all, however, to the zoologist is, perhaps, the Burbolt, or Eel-pout (*Lota vulgaris*), No. 111, this fish being the only indigenous member of the Cod family that is restricted to fresh water. It is a nocturnal species, growing to a length of two or three feet, much addicted to hiding itself within holes and crannies on the river banks during the daytime, and sallying out in search of food at night. In contour it very much resembles the Ling (*Molva*), it being one of those elongated, Eel-shaped forms, in which the hinder dorsal and anal fins extend throughout the greater length of the body. An anticipa-

tion or foreshadowing of this Eel-like continuity of the fins in question is met with in those typical Cod-species in which as many as three dorsal and two anal fins take the place of the short single or double dorsal, and single anal fin developed in ordinary fishes. A highly remarkable, but as yet apparently unexplained physiological function is associated with the first dorsal fin in the genus *Motella*. As may be observed of examples confined in the tanks of an aquarium, this fin is sunk within a deep groove, above which, although of a considerable length, it is elevated to a very small extent. During life, even while the fish is otherwise quiescent at the bottom of the water, this fin is in a constant state of vibration, undulating from before backwards, much after the manner of the dorsal fin of the Pipe-fish (*Syngnathus*) when used for locomotion, but more rapidly and continuously. The Rocklings are litoral species, that in a state of nature usually lie hid beneath stones, or among the tangled masses of sea-weed that line the shore; and it would seem by no means improbable that the undulations of this fin, in connection with its groove, subserve the purpose of bringing fresh streams of water to the vicinity of the respiratory organs, the fish being thus enabled to live in small holes and crannies, that would otherwise be too stagnant for its healthy existence. The commonest form, known as the Five-bearded Rockling (*Motella mustela*), is very plentiful around our coasts. It is distinguished, as its name implies, by the possession of five cirrhose appendages or barbels, four of which are developed from the upper and one from the lower lip. Its ordinary length is about twelve inches, and its colour in life is a rich chestnut or olive brown, with bronze reflections. A larger and yet more handsome species is the Three-bearded Rockling (*Motella tricirrata*), attaining to a length of as

much as twenty inches; the colour of the body in the adult fish varies from cream colour to a light or reddish chestnut, variegated with innumerable black spots or blotches, while the long dorsal and anal fins are tinged with brilliant crimson. Fine examples of this species are included in the spirit-preserved series of the Day Collection.

FAMILY II.—SNAKE FISHES (*Ophidiidæ*).

Body elongated; the vertical fins usually confluent, without any anterior dorsal or anal sub-divisions; the

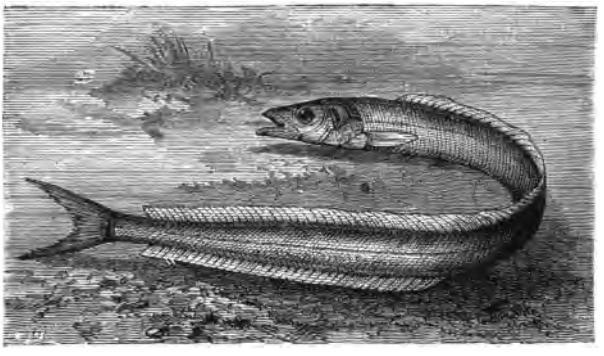

FIG. 17.—SAND-EEL (*Ammodytes tobianus*).

ventral fins rudimentary, represented merely by a pair of bifid filaments, or entirely absent; branchiostegal rays seven or eight in number; air-bladder present or absent.

The Bearded Ophidiom (*Ophidiom barbatum*), No. 118, and Drummond's Echiodon (*Fierasfer dentatus*), No. 119, are two elongated Eel-like forms, which, while plentiful in the Mediterranean, are very rarely taken upon our coasts. Much more abundantly represented members of the same group are the Launches, or Sand-Eels, including the Greater Launch (*Ammodytes lanceolatus*), No. 120, the Lesser Launch (*A. tobianus*), No. 121, and the Smooth Launch

(*A. cicirellus*), No. 122. The last-named species is a Mediterranean form, somewhat doubtfully recorded from British waters. The two former fish are very plentiful, gregarious in habits, and, when freshly caught, highly esteemed for the table on the South coast and in the Channel Islands. The Sand-Eels take their names from their habit of burrowing in the sand, out of which they are dislodged in vast numbers at ebb-tide with forks, rakes, spades, and every implement available for the purpose. Sand-eeling excursions by moonlight at the low spring tides, in the sandy bays of the islands of Jersey and Guernsey, constitute a favourite and highly exciting pastime, indulged in indiscriminately by the members of both sexes and all ranks. While the common form or Lesser Sand-Eel rarely measures six inches in length, the larger one may sometimes exceed twice these dimensions.

FAMILY III.—LONGTAILS (*Macruridæ*).

Body terminating in a long, compressed, tapering tail, clothed with spiny, keeled, or striated scales ; dorsal fins two in number, the anterior one very short, the second very long, continued to the end of the tail ; the anal fin very long, corresponding in its development with the second dorsal ; no distinct caudal fin.

This family is restricted to a few deep sea or abyssal forms, which are likened by Dr. Gunther to "Deep sea Gadidæ." Of the forty known species, a single type, the Norwegian Coryphœnoid (*Coryphœnoides rupestris*), No. 123, that attains to a length of eight or ten inches, has been rarely taken in deep water off the Faroe and Shetland Islands.

FAMILY IV.—FLAT FISHES (*Pleuronectidæ*).

Body flattened, strongly compressed, naked or clothed with scales, one of the sides coloured, the other normally colourless; both eyes, in adult fish, located on the superior or coloured surface, the bones of the two sides of the head unequally developed, those forming the lower surface almost rudimentary; a single long dorsal and anal fin; branchiostegal rays six to eight in number; air-bladder absent.

The Flat fishes, in common with the Cod fishes and Herring tribe, rank among those forms which from an economic view are of the highest utility to man, and constituting as they do one of the most important subjects of our fishing industries, their more elaborate description may be appropriately left to the handbooks devoted to our Food-fishes and Sea Fisheries. The remarkable structural peculiarity which distinguishes the Pleuronectidæ from all other fish, i.e. the unsymmetrical development of the head, and the location of the two eyes upon one side of this region, it is singular to relate, does not represent the condition in which as young fish they first leave the egg. At such an early period they are bilaterally symmetrical, with an eye on either side like all ordinary fish, but from the acquired habit of lying constantly on one side, the eye-socket on the side directed towards the ground becomes gradually obliterated, and the eye itself, pushing its way over the top of the head, ultimately takes its place near the other eye on that side, which is popularly known as the upper surface. Simultaneously with this migration of the visual organ, the pigmentary substances which give to the adult fish its characteristic tint become developed only on that side, the so-called upper surface, which is exposed to the light, the opposite or underneath one remaining colourless. In the majority of our

British species it is the right-hand side which lies uppermost, and is consequently coloured, the reverse, however, obtaining in the Turbot (*Rhombus maximus*), No. 126 ; the Brill (*Rhombus lævis*), No. 127 ; Eckstrom's and Muller's Top-knot (*Zeugopterus unimaculatus*) and *Z. punctatus*), Nos. 128 and 129 ; and the Sail-fluke and Megrim (*Arnoglossus megastoma* and *A. laterna*), Nos. 130 and 131. Reversed examples of a normally right or left coloured species are, however, not unfrequent, as also so-called "double" examples, in which the characteristic colour is developed on both sides of the body, and "albinos," with both surfaces more or less completely colouress. Examples illustrating all of these abnormal developments will be found in the spirit-preserved series in the Day Collection. The largest British representative of the Pleuronectidæ is the Halibut, or Holibut (*Hippoglossus vulgaris*), No. 124, taken in the North Sea, but attaining to its largest dimensions in the colder waters off Newfoundland, Greenland, and Iceland. An example is recorded by Olassin to have been captured near the last-named station, that measured but little short of twenty feet, while a length of six or seven feet, with a weight of from 300 to 500 lbs. is of frequent occurrence. The long rough Dab (*Hippoglossoides limandoides*), No. 125, much resembles the Holibut in its proportions, but rarely exceeds a length of twelve or fifteen inches, and is distinguished from it among other points, according to Dr. Day's 'British Fishes,' by the possession of a strong, spur-like spine developed in front of the anal fin, which, according to the same authority, is absent in the Holibut. In the type specimen of the last-named fish contributed by Dr. Day to the Buckland Museum, there is, nevertheless, an exceedingly strong spine developed in the position indicated, while in that of the Rough Dab it is scarcely perceptible. In several other Flat fish, including

the orange-spotted Plaice (*Pleuronectes platessa*), No. 123; the Pole, or Long Flounder (*P. cynoglossus*), No. 134; the Dab (*P. limanda*), No. 135; and the common Flounder (*P. flesus*), No. 136, a similar spine is more or less conspicuously developed, while in the remaining member of the same genus, the Smear Dab (*P. microcephalus*), No. 133, it is altogether absent.*

Of the genus *Solea*, including the various species of Soles, there are four distinct British forms. These are the common Sole (*Solea vulgaris*), No. 137, so highly esteemed for the

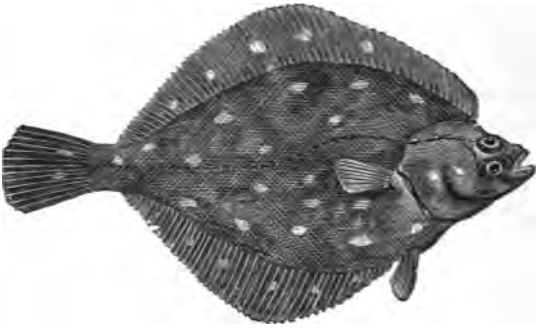

FIG. 18.—PLAICE (*Pleuronectes platessa*).

table. The yellow-coloured Lemon Sole (*Solea lascaris*), No. 138, an inferior fish, often substituted for ordinary soles since these have become so scarce, in a great measure through the wholesale destruction of the young fry by machine trawling, and the use of fine meshed nets during the spring months of the year. The Variegated Sole (*S. variegata*), No. 139, is a smaller and rarer form, remarkable for the

* No special use has hitherto been apparently assigned to this anteriorly directed anal spur; possibly it may be utilised in some way like the bony accessory organs of the Shark during the congress of the sexes—while in the case of a large fish like the Holibut it might subserve as a formidable offensive weapon.

ornamental bands of a darker hue that are developed on a ground of rich chestnut-brown; and lastly the Solonette, or Little Sole (*S. lutea*), No. 140, rarely exceeding a length of four inches, and having small brown or darker spots scattered over a ground tint of uniform stone-grey. In illustration of the large size to which the ordinary Sole, if left undisturbed, will not unfrequently attain, reference may be made to the casts of a pair from the Irish coast now on view in the Buckland Museum, which weighed together no less than twelve pounds. Their length in each instance closely approaching two feet.

All of the Pleuronectidæ are remarkably elegant swimmers, propelling themselves through the water by graceful undulations of their entire body. The Soles are especially worthy of notice in this respect, and as has been observed of examples acclimatised in aquaria, possess the faculty of converting their body, with its continuous fringe-like dorsal and anal fins, into a complete sucking-disc, wherewith they can adhere at will to the glass sides of the tank in which they are confined. The scales in the majority of the Pleuronectidæ are very beautiful as microscopic objects, being of the ctenoid type, deeply serrated and delicately sculptured. In the Turbot (*Rhombus maximus*), as a remarkable exception, there are no scales at all, but the surface of the body is roughened with bony tubercles, giving some ground for the anticipation that this form may possibly have been evolved from an ancestral line distinct from that whence the ordinary scale-covered Flat fishes sprang.

Although the Pleuronectidæ are usually regarded as an essentially marine group, one species, the Flounder (*Pleuronectes flesus*), ascends rivers into brackish and even fresh water. Examples of this fish are on view in one of

the freshwater tanks in the Buckland Museum, which have lived there in company with purely fluviatile species for a period of several years.

ORDER III.—*Physostomi.*

All the fins rays articulated, excepting the first ray in the dorsal and pectoral fins, which are frequently more or less ossified. The bladder when existing, provided with a distinct pneumatic duct.

FAMILY I.—ARGENTINES OR SILVERSPOTS (*Sternoptyclidæ*).

Margin of upper jaw formed partly by the premaxillary and partly by the maxillary bones, both of which are provided with teeth. Opercular bones not fully developed ; rows of luminous eye-like spots developed along the lower surface of the abdomen, and sometimes on other regions of the body.

Two small and rare species that naturally inhabit the deeper waters of the ocean, but are occasionally washed upon our coasts after stormy weather, have to be included in the British list. These are the Half-armed Silverspots (*Argyropelecus hemigymnus*), No 141, and the Sheppy Argentine (*Maurolicus pennantii*), No. 142. Both possess in common those ventral rows of problematic structures that, shining like burnished silver, have won for them the popular title of "Silver Spots," and which in an allied exotic form (*Astronethes*) have been demonstrated by Professor Reinhardt to be endued with undoubted phos-

phoric properties. The external resemblance of the first-named type to the immature state of some laterally compressed fish, such as a Dory or Boar-fish has been observed by previous writers, while the Sheppey Argentine may be compared in shape and proportions to a young Sprat or Herring. Examples of both these species will be found among the spirit series of the Day Collection.

FAMILY II.—THE SALMON TRIBE (*Salmonidæ*).

Margin of the upper jaw formed by the pre-maxillary and maxillary bones; barbels not developed; dorsal fins two in number, the anterior of normal construction, the posterior one destitute of fin rays, simply membranous, and constituting the so-called "dead," or "adipose" fin; the ova passing into the abdominal cavity before extrusion.

The Salmon tribe is of such high importance from a commercial point of view, and has now for several centuries occupied so prominent a position in our State legislation, that one or more handbooks are deservedly being devoted to its biography, innumerable varieties, and highly perfected methods of artificial cultivation. Such being the case, the briefest possible space is here allotted to this group, the reader specially interested in the Salmonidæ being referred to the companion handbooks for further information. As is befitting so estimable and noble a fish, the lordly Salmon, or "King of Fishes," as his worshippers have dubbed him (*Salmo salar*), No. 143, takes his place at the head of the family tree. No more instructive introduction to the various aspects, proportions, and growth phases of this important species could be obtained than a visit to the magnificent series of casts included in the Buckland Museum, all the clever handiwork of the enthusiastic

naturalist to whom the nation is indebted for the collection that bears his name. The value of many of these casts is greatly augmented through the fact that they were painted with life-like fidelity by the late Mr. H. L. Rolfe, whose skill in this artistic department was so prominent as to have won for him with icthyologists the justly-merited title of "The Landseer among Fishes!" Among this, so-to-say, "classic series" of Salmon casts, will be found that very monster of his tribe, the celebrated Tay Salmon, or "King of Scots," as Frank Buckland named him, which weighed in the flesh no less than 70 lbs., and measured from snout

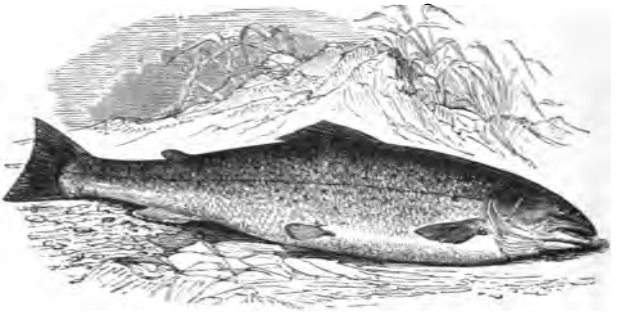

FIG. 19.—SALMON (*Salmo salar*).

to tail as much as four feet five inches. Here also the renowned Rhine fish, weighing a pound less than his Scotch contemporary, but with the larger dimensions of four feet eight inches, and many a noble fifty pounder, hailing in almost every instance from "across the border." Next to these we find a long line of dissipated Kelts, distinguished by their lean proportions and incurved projecting jaws, so advantageously utilised by the male fish in excavating the gravelly spawning beds wherein the female deposits her many thousand eggs. The several earlier developmental phases of the Salmon, including the gayly spotted and

banded "parr," silvery "smolts," and half-grown "grilse," may be advantageously studied in the spirit series forming the Day Collection. A singular circumstance connected with the Salmon, and pertaining also to other members of its tribe, is the fact that the males may become sexually mature, have their milts fully developed, and fecundate the eggs of the female when not advanced beyond the "parr" stage, and measuring only five or six inches in length. Examples of such precociously developed Salmon were in March of the present year, 1883, sent to the writer by Sir Edmund Buckley from his estate at Dinas Mawddwy, North Wales, and who informed him that it is in that neighbourhood regarded as a distinct species, locally known as the "Samlet," and held to be distinct from the ordinary parr. In support of this view, females of this early "parr" stage with matured ovaries are likewise reported to have been taken, but no well authenticated instances of such an abnormal development are as yet on record.

The marine and estuary-frequenting Salmon-trout, Salmon-peal, or Sea-trout (*Salmo trutta*), No. 144, includes two well-marked varieties, the so-called White Salmon "Whitling," or Hirling, the *S. albus* of many writers, and the Welsh and Cornish forms, locally known as the "Sewin" Blue-poll, or Bull-trout, distinguished by earlier ichthyologists by the titles of *S. cambricus* and *S. eriox*. As ably demonstrated in Dr. Francis Day's 'Fishes of Great Britain,' which all interested in the history and affinities of the Salmonidæ should consult, this species passes by imperceptible gradations into the purely fluviatile river Trout (*S. fario*), No. 146, with its varieties too abundant for enumeration in this brief handbook, and likewise, there is good reason to believe, into the famous non-migratory Loch Leven Trout (*Salmo*

levenensis), No. 145, which has for many years past been the subject of successful culture at Sir J. Gibson Maitland's world-renowned fishery establishment at Howietown, N. B. The Alpine Char (*S. alpinus*), No. 147, confined to the deep elevated lakes of Great Britain and Ireland, runs in like manner through innumerable variations, which are figured and described in Couch's 'Fishes of the British Islands' under the several titles of the Willoughby's Char of Windermere, the Torgoch of Llanberris, Gray's Char from Lake Melvin, the Eninskillen, or Cole's Char from Lough Esk and other Irish lakes, while the typical Alpine Char, abundant throughout the Scandinavian peninsular, is reported from the Highlands of Scotland. The male fish in many of these varieties is distinguished during the breeding season for the brilliant vermilion hue of the lower region of the body, and numerous spots that decorate its sides. The American Brook Trout, or Char (*S. fontinalis*), No. 148, has now become so thoroughly acclimatised in many of the rivers of this country as to claim admittance to the British list. The marginal bands of a creamy hue that decorate the pectoral fins serve to distinguish it readily from any of the many varieties of *S. fario*. Many interesting hybrid forms have been obtained belonging to this species and the last-named type. The true Smelt, Sparling, or "Cucumber-Smelt," as it is sometimes called with reference to its delicious cucumber-like aroma when freshly caught (*Osmerus eperlanus*), No. 149, is among the smallest of the British Salmonidæ, rarely exceeding a length of nine or ten inches. It is of eminently gregarious habits, being captured in abundance between the autumn and early spring months on various parts of our coasts, and during the latter season entering the mouths of rivers to deposit their spawn. The several

species of *Corregoni* are likewise gregarious Salmonidæ, restricted, however, like the Chars, with one exception (No. 150, which is both a marine and freshwater form), to our larger upland lakes, and subject in a similar manner to much local variation. In their size, shape, and their silvery colouration they bear no inconsiderable resemblance to the members of the Herring tribe, whence their popular name of "Freshwater Herrings," but may be immediately distinguished from such fish by the possession of a distinct adipose dorsal fin. The four British species as recognised by most authorities are the Houting, or sharp-snouted Corregonus (*Corregonus oxyrhynchus*), No. 150; the Guiniad of Bala, and other North Wales lakes (*C. clupeoides*),* No. 151; the Vendace of Scotland (*C. vendesius*), No. 152; and the Pollan and Powan of Ireland and Northumberland (*C. pollan*), No. 153. The Grayling (*Thymallus vulgaris*), No. 154, is an example of the Salmon family, specially abundant in the streams of Hampshire and other of our southern counties. The Hebridal Smelt (*Argentina sphyræna*), No. 155, which closes the list of the British Salmonidæ, is a small northern marine type, not unfrequently taken among the islands to the North of Scotland, and of which a preserved specimen will be found in the series forming the Day Collection.

FAMILY III.—PIKES (*Esocidæ*).

Body covered with scales; barbels none. Margin of upper jaw formed mesially by the intermaxillary and laterally by the maxillary bones; no adipose fin, the single dorsal fin developed towards the caudal extremity of the body.

* Specimens of this type from Bala Lake, the gift of Sir Watkin Williams Wynn, Bart., are on view in the Buckland Museum.

The genus *Esox*, including a single British species, the common Pike, or Jack (*Esox lucius*), No. 156, and some half-a-dozen exotic species, all inhabitants of fresh water, is alone comprised in the family Esocidæ. The above-named well-known British type is the largest of our purely fresh-water fishes, and in connection with its remarkable voracity enjoys a world-wide reputation. Every description of fish, with the exception, perhaps, of the prickly Perch, water-fowl, and even water-rats fall victims to its insatiable appetite, and instances have been recorded even of large Pike greatly pressed by hunger seizing the muzzles of cattle and horses when repairing to the riverside to drink. A weight of as much as sixty or seventy pounds is not unfrequently attained by a full-grown Pike. Numerous admirable casts of monster specimens of this destructive fish will be found in the Buckland Museum, and likewise an example of a half-grown fish which was captured in the act of gorging one of its own species about equal to itself in size.

FAMILY IV.—SAURY PIKES (*Scombresocidæ*).

Body covered with scales, those developed along each side of the belly keeled or carinate; upper jaw-bones constituted as in the Esocidæ; the lower pharyngeal elements united into a single bone; dorsal fin developed opposite the anal one towards the caudal region; no adipose fin; air-bladder without a pneumatic duct.

This family includes the Gar-fish, Gor-bill, or Long-nose (*Belone vulgaris*), No. 157; the Saury Pike or Skipper (*Scombresox saurus*), No. 158; and the Flying-fish (*Exocetus evolans*), No. 159. The two first-named types are compressed elongated forms remarkable for the beak-like prolongation of their upper and lower jaws, suggestive of

the modification already recorded of the Sword-fish, only in these two instances it is the lower in place of the upper jaw that is the more developed. A remarkable peculiarity of the Gar-fish when boiled, is the fact that the bones assume a bright green hue ; this circumstance has won for it the title of the "Greenbone," and among the uninitiated has given rise to the erroneous idea that the tint is due to the presence of copper, and that the fish is therefore unfit for food. A very interesting series of the metamorphoses of this species

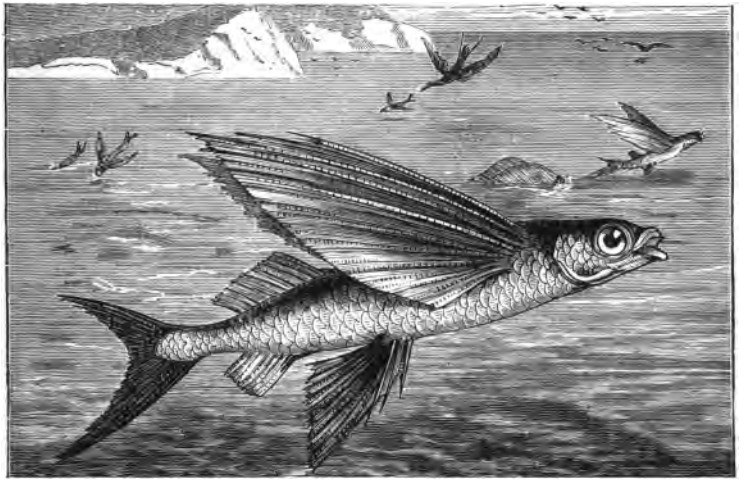

FIG. 20.—FLYING-FISH (*Exocetus volitans*).

from the egg to the full-grown fish will be found in the spirit series of the Day Collection. Young examples in which only the lower jaw is abnormally developed, were originally described as a distinct species under the title of the "Half-beak" (*Hemiramphus*). The greater Flying-fish (*Exocetus volitans*), No. 159, rarely captured in British waters, in shape, size, and colour much resembles a Herring, with the exception that the pectoral fins are so enormously developed that the fish is enabled with their assistance to

make long leaps, resembling flight, above the surface of the water. It is in the habit of associating in shoals, and where abundant, in the Mediterranean and more southern seas, is the favourite prey of the Dolphin-fish (*Coryphæna*), and the Albatross, and other sea-birds, which pursue it unrelentingly through air and water as represented in the accompanying illustration. A British example of the Flying-fish is among the more important desiderata of the Buckland Museum. The Lesser Flying-fish (*Exocetus evolans*), is doubtfully reported as having been on one or more occasions taken off the British coast.

FAMILY V.—CARP TRIBE (*Cyprinidæ*).

Body, excepting the head, usually covered with scales; the margin of the upper jaw formed by the intermaxillary bones alone; the mouth toothless, but teeth developed in one, two, or three bones upon the strong falciform, lower pharyngeal bones; no adipose fin; air-bladder large, divided by a constriction into an anterior and posterior portion, or into a right and left sub-division, enclosed within an osseous capsule.

The Carp tribe embraces all our most familiarly known coarser species of freshwater fish, such as the common Carp (*Cyprinus carpio*), No. 160; the Crucian Carp (*Carassius vulgaris*), No. 161; the Barbel (*Barbus vulgaris*), No. 162; the Gudgeon (*Gobio fluviatilis*), No. 163; the Roach (*Leuciscus rutilus*), No. 164; the Chub (*L. cephalus*), No. 165; the Dace (*L. vulgaris*), No. 166; the Rudd (*L. erythrophthalmus*), No. 167; the Minnow (*L. phoxinus*), No. 168; the Tench (*Tinca vulgaris*), No. 169; the Yellow Bream and White Bream (*Abramis brama* and *A. blicca*), Nos. 170 and 171; the Bleak (*Albernus lucidus*), No. 172; and the

Common Loach and Spined Loach (*Nemachilus barbatulus* and *Cobitis tænia*), Nos. 173 and 174. All of these species will be found extensively represented among both the collection of casts in the Buckland Museum and the spirit-preserved specimens forming the Day Collection, a large number of them being likewise exhibited alive in the aquaria belonging to the Museum of Pisciculture. Since, however, this family group falls specially within the province of the corresponding handbooks, treating upon the art of angling and general pisciculture, the space that might have been otherwise devoted to its biography has been bestowed upon less familiar forms. One or two types and their varieties deserve, nevertheless, a more extensive notice. Among these must be mentioned a variety of the Common Carp, in which the bones of the head are so deformed that it closely resembles that of a pug-dog. Casts of this variety will be found in the Buckland Museum. The Crucian Carp is notable for exhibiting a large number of varieties, including the well-known gold and silver Carp with their innumerable interblendings, originally introduced from China,* the normal-coloured fish, comprising the common large head, sub-cylindrical form, formerly and still frequently denominated the Prussian Carp (*Cyprinus gibelio*), and the much compressed Bream-like form, which retained the title of the Crucian Carp, or Carp-Bream. A remarkable example of this variety, having an oval perforation of about an inch in length and half an inch in breadth, through the muscular tissues of the hinder region of its body, was received by the writer at the Manchester Aquarium, from Mr. Henry King, of Great Portland Street, in the year 1875. The Tench, like the Carp, is notable for a gold coloured variety, obtained from

* By some authorities the Gold-fish is admitted to the rank of a distinct species, under the title of *Cyprinus*, or *Carassius auratus*.

Germany, the tint of which is, however, a paler yellow, more resembling that of the cowslip or primrose, variously mottled with black or brown; this form, which is popularly known by the name of the Golden Tench, or "Gold Schlei," is well represented in the tanks in the Buckland Museum.

FAMILY VI.—HERRING TRIBE (*Clupeidæ*).

Body, excepting the head, covered with scales; the abdomen commonly compressed and with a serrated edge; no barbels; the margin of the upper jaw composed of the maxillary and intermaxillary bones; no adipose fin; the dorsal fin not elongated; all gill-openings usually very wide; air-bladder more or less simple.

This highly important fish group includes as many as half-a-dozen species indigenous to British waters, and a large number of exotic forms distributed throughout the temperate and tropical seas, many entering and thriving in fresh waters that communicate freely with the ocean. All the British species are of such great economic value, that their full description is appropriately left for the handbooks treating upon the food question, little more than a mere summary being here given of their respective names. First on the list comes the Anchovy (*Engraulis encrassicholus*), No. 175, a species occurring occasionally, according to Couch, in such abundance off the Cornish coast, that with the use of proper appliances it might be developed into an important fishery, whereas at present the entire bulk of this piquant fish, utilised in various ways in English cookery, is derived from the Mediterranean. Examples of the Anchovy, the first acclimatised in this country, were successfully imported by the writer in the year 1875, from Morecambe Bay to the tanks of the Manchester Aquarium. The Common Herring

(*Clupea harengus*), No. 176, apart from the prominent position it occupies among our British fisheries in its adult state, provides for the tables of the wealthy in the days of its youth that very highly esteemed delicacy known as "Whitebait." Originally the Whitebait was supposed to represent a distinct species of British fish, and was so described by Yarrel under the title of *Clupea alba*. Yarrel's types, however, deposited in the British Museum, were shown by Dr. Gunther to be the young only of the Herring, every phase of growth from the Whitebait to the adult state having been produced. Proof of a more substantial nature in the same direction was adduced by the writer in the years 1874 and 75, through the successful cultivation of Whitebait in the Manchester Aquarium. These fish, which when first imported from Mr. Parry Evans' famous Salmon Weir at Colwyn Bay, North Wales, measured but from one to two inches in length, had grown within the course of a year to small, though fair-sized Herrings. The feat of artificially cultivating Whitebait, though not previously achieved at any other aquarium, and more especially an inland one, was subsequently carried through with success at the Brighton and Southport institutions, and likewise for the second time by the writer at the Westminster Aquarium in the year 1876. The great difficulty attending the rearing of these interesting little fish was connected with the food question. The natural diet of the Herring in its young and adult states, consists essentially of living prey, including chiefly Entomostraca and the larval phases of higher Crustacea. Such pabulum being difficult to obtain so far inland as Manchester, a variety of substitutes were offered them by way of experiment, but for a long time without success. Ultimately an irresistible *bonne-bouche* was provided in the shape of the hard adductor muscle of the common Mussel

(*Mytilus*), which, minced very fine, was devoured with avidity by the little Whitebait, and thenceforward constituted their normal nutriment. A like food-material was also successfully utilised by the writer for rearing Lobsters from the egg through their various larval metamorphoses to the adult form, and might be advantageously adopted for the cultivation of a variety of young marine fish and other organisms hitherto found difficult to rear. Should there be sufficient space at disposal at the Exhibition Aquarium the writer has proposed to devote a couple of small tanks to a repetition of the experimental cultivation of Whitebait and Lobsters just described.* While it was thus proved to demonstration that the genuine Whitebait represented by the *Clupea alba* of Yarrel, is no more nor less than young Herring, it has to be admitted that the delicacy as supplied to us at the Metropolitan restaurants, and even at classic Greenwich, may and does not unfrequently include a very menagerie of piscine fry; young Gobies, Flat-fish, Weevers, Sand-eels, Shrimps, and even Sticklebacks, being, indeed, often recognisable among the heap of slain that should consist entirely of Clupeidæ. The Sprat (*Clupea sprattus*), No. 177, distinguished from the Herring by its small size and strongly serrated ventral edge, the Pilchard (*C. pilchardus*), No. 180, and the two fish known as the Allis-Shad (*C. alosa*), No. 178, and the Twait-Shad (*C. finta*), No. 179, conclude the list of British Herrings. The Shads, which resemble the ordinary Herring in shape, but are of much larger size, sometimes attaining to a length of three or four feet, are remarkable for their habit of entering the mouths of rivers and

* For a fuller account of these exper... reader is referred to the writer's paper on "The Constr... and Utility of Aquaria," read before the Societ... st, 1876, and published in the succeeding numbe...

ascending into perfectly fresh water to deposit their spawn. During their migration to fresh water they are much esteemed for food. The Severn in the months of April and May is especially famous for its Shad fisheries.

FAMILY VII.—EELS (*Muræniдæ*).

Body very elongate, cylindrical or band-shaped, naked, or with rudimentary scales; gill-opening very small; vent remote from the head; no ventral fins; vertical fins, if present confluent, or separated only by the projecting tip of the tail; the humeral arch not attached to the skull.

Their attenuate snake-shaped bodies, absence of ventral fins, and the continuity of the long dorsal and anal fins, distinguish the members of the Eel tribe conspicuously from all other fish. The most familiar British form, the common freshwater or Silver Eel (*Anguilla vulgaris*), No. 187, includes a large number of local varieties, formerly described as distinct species under the respective titles of the Sharp-nosed, Broad-nosed, Dublin, and Snig Eels. It is a remarkable circumstance that this fish, though capable of breeding in ponds or rivers, repairs, where facilities are afforded it, to salt-water to deposit its spawn, its habits being in this respect the converse of that of the Salmon. The fry, when hatched, ascend the rivers in vast numbers under the form of "Elvers," to the waters from whence their parents migrated. Artificial ladders, formed of hay or straw loosely twisted into bands, are often provided to enable the little Elvers to climb over weirs, and other natural obstructions, that would otherwise intercept their upward progress. descent ult Eels to the spawning-beds likewise place e period of their migration, which s. alculated to within a few hours,

being taken advantage of by the riparian proprietors for their capture. Mr. Eden, of the Buckland Museum, has informed the writer that he was present in November, a few years since, at an Eel-taking from the river Erne in Ireland, when the fish, to the amount of no less than ten tons, were intercepted in a single night, at one of six stations established on the river, during their migration from Loch Erne to Donegal Bay to spawn. The Eels thus captured are immediately nailed down in trunks—the boxes used in spring for the transport of Salmon being utilised in the instance quoted—and are then despatched alive to the English markets. Eels not only live for a long while out of water, but often voluntarily leave the ponds or rivers they normally inhabit, in search of food or more congenial residence. A weight of eight or ten pounds, with an average length of four feet, is not uncommonly attained by the Silver Eel; several casts of specimens possessing these fine proportions will be found in the Buckland Museum. The Conger Eel (*Conger vulgaris*), No. 182, is an exclusively marine species, growing to a length of no less than six to eight feet, with a weight of from 50 to 60 lbs. to over a hundredweight. Doubtless many of the legendary tales respecting the Sea-serpent originated in connection with giant Congers. The largest examples are captured off rocky coasts, such as those of Cornwall, Devonshire, and the Channel Islands. Though but rarely seen in the London markets, it with proper treatment yields a most appetising and nutritious food, and is largely utilised as the basis of various soups, such as mock turtle, and in the Channel Islands is made into the soup locally known as *bouillabaisse*. Conger stewed after the Lancashire fashion in milk, with a little butter, pepper, salt, and just a flavour of union, can be highly recommended by the writer. Casts of remarkably large specimens of this Eel

are, on view in the Buckland Museum, while living ones may be seen in the Exhibition Aquarium. When thus kept in confinement it is highly desirable to keep large specimens separate, they ravenously devouring any other fish of less size than themselves, not excepting individuals of their own species. The young of the Conger was originally described as a separate form, under the title of the Anglesea Morris (*Leptocephalus morrisii*). The Muræna (*Muræna helena*), No. 183, is a rare fish on the British coast, but abundant in the Mediterranean and tropical

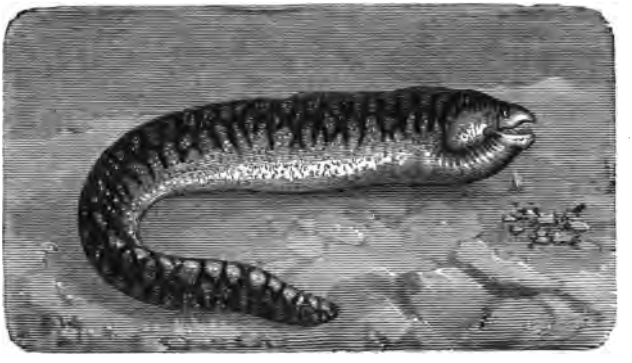

FIG. 21.—MURÆNA (*Muræna helena*).

seas, distinguished by its compressed contour, absence of pectoral as well as ventral fins, and the beautiful leopard-like mottlings of its naked integument. An exceedingly fine example of this fish, derived from a Continental source, will be found among the spirit series forming the Day Collection.

SUB-ORDER IV.—*Lophobranchii.*

The gills not laminated, but composed of small rounded lobes attached to the branchial arches; the gill-cover

represented by a simple plate; air-bladder without a pneumatic duct; a dermal skeleton composed of numerous indurated polygonal plates, usually developed; the snout prolonged; mouth terminal, toothless.

FAMILY I.—PIPE-FISHES (*Syngnathidæ*).

Gill-openings reduced to a minute opening near the upper posterior angle of the gill-cover; one soft dorsal fin, no ventrals, and one or more of the other fins frequently absent.

The *Syngnathidæ*, including the Pipe-fishes and Sea-Horses (*Hippocampi*), comprise some of the most remarkable-

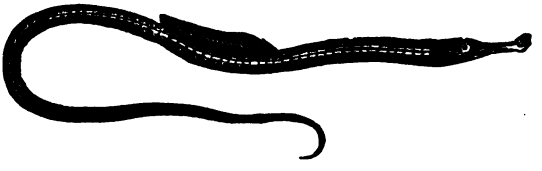

FIG. 22.—PIPE-FISH (*Nerophis æquoreus*).

looking forms in the world's fish-fauna. The Pipe-fishes, or Sea-adders, as they are sometimes called, are attenuated snake-like fish, represented by as many as five British species. These are the Broad-nosed Pipe-fish (*Syphonostoma typhle*), No. 184; the Greater Pipe-fish (*Syngnathus acus*), No. 185; the Ocean Pipe-fish (*Nerophis æquoreus*), No. 186; the Snake Pipe-fish (*N. ophidion*), No. 187; and the Worm Pipe-fish (*N. lumbriciformis*), No. 188. The majority of these types will be found among the spirit-preserved series of fish forming the Day Collection. A peculiarity common to all the Pipe-fishes, and also the Sea-Horses, is connected with their mode of locomotion. This is effected entirely by the action of the unpaired dorsal fin, the rays of which,

vibrating in rhythmical order from before backwards, convert this organ into an efficient screw-propeller, by the aid of which these fishes progress through the water in a singularly beautiful manner, the body during such locomotion usually assuming a vertical position. A similar mode of locomotion in which, however, the anal fin likewise takes a part, has been recorded by the writer of the John Dory and Boar-fish. The *Syngnathidæ* are further remarkable for the phenomena attending the process of reproduction. The eggs deposited by the female are not, as with the majority of fish species, left to the mercy of the waves, but are consigned to the care of the male, who receives them into a pouch-like excavation of the ventral surface of his body, and there nurses them until the young are hatched. It was formerly, but erroneously, supposed that, after the manner of the kangaroo, the young fish retreated for protection to the parental pouch on the approach of any disturbing influence. Of the Sea-Horses, or *Hippocampi*, but one species is rarely taken on the British coast, this being the Short-nosed variety (*Hippocampus antiquorum*), No. 189. It is a small form, not exceeding two or three inches in length, having a head and shoulders grotesquely resembling the conventional type of a horse that represents the knight on a chess-board, the body thence tapering away into a sub-cylindrical, highly flexible appendage, wherewith the little animal can attach itself to sea-weeds and other submarine objects, in much the same fashion that a New World monkey utilises its prehensile tail. In the spring of the year 1875, some very extraordinary coloured specimens of this singular little fish, obtained from the Mediterranean, were supplied to the writer at the Manchester Aquarium by Mr. G. H. King, of 192 Great Portland Street. Some of these were bright

red, others pale pink, bright or light yellow, and even almost pure white, with many other interblending shades. Such colours had apparently been assumed by the fish in keeping with, and as a means of concealment among, the brilliant vegetation and zoophytic growth indigenous to the locality from whence they were derived. These tints in confinement gradually disappeared, until the fish had assumed the normal light brown or speckled hue by which they

FIG. 23.—SEA-HORSE (*Hippocampus antiquorum*).

are generally characterised. A somewhat interesting fact was elicited by the writer while making some coloured sketches of the individuals just referred to. Two examples were at this time isolated in separate glass receptacles some few yards apart, when unexpectedly a sharp little snapping noise was heard at short and regular intervals to proceed from one of the vases placed on a side table, and to which a response in a like manner was almost immediately made from

the vase close at hand. On seeking for the cause, the sound was found to proceed from the mouths of the little *Hippocampi*, which were thus conversing with, or signalling to, one another. The noise observed was produced by the muscular closing and sudden expansion of the lower jaw, and much resembled in strength and tone the snapping sound produced for a similar purpose, but in this instance with its claw, by the little scarlet Prawn (*Alpheus ruber*), found in the Channel Islands. A difficulty in keeping Sea-Horses is

FIG. 24.—EXOTIC SEA-HORSE (*Phyllopteryx eques*).

usually presented in connection with their food supply, they subsisting naturally on small Crustacea, such as Sand-hoppers (*Gammarus*), and the Opossum Shrimp (*Mysis*). Such supply failing in Manchester, the writer improvised a successful substitute in the form of the larvæ of the common gnat (*Culex pipiens*), and other water insects. A much larger type, obtained in the Mediterranean, and often exhibited in aquaria, is the Branched Sea-Horse (*Hippocampus ramolosus*), ornamented about the head and neck with long filamentous processes that may be likened to

a mane. In an allied, but still more extraordinary Australian type (*Phyllopteryx eques*), represented in the accompanying engraving (Fig. 24), leaflike appendages of the integument are produced so luxuriantly from various points of the surface of the body that the animal is scarcely to be distinguished from a branch of sea-weed.

SUB-ORDER V.—*Plectognathi.*

Body covered with simple scales, scutes or spines, gills pectinate, gill opening in front of the pectoral fins, very narrow; a soft dorsal fin developed posteriorly opposite to a corresponding anal one; ventral fins absent, or reduced to one or more spines; air-bladder without a pneumatic duct.

FAMILY I.—FILE-FISHES (*Sclerodermi*).

Jaws armed with distinct teeth. Skin with scutes, or rough; elements of spinous dorsal and ventral fins usually present.

The fish belonging to this group are essentially inhabitants of the tropical seas, solitary individuals representing two species, the spotted File-fish (*Balistes maculatus*), No. 190, and the Mediterranean File-fish (*B. capriscus*), No. 191, having on rare occasions been taken as stragglers in British waters. They are oblong compressed forms, remarkable for the simple slit-like opening to the gill cavity, the armature of their body, which consists of closely apposed polygonal plates in place of overlapping scales and for the modification of the first dorsal fin, which consists somewhat after the manner of the Trumpet-fish (*Centriscus*), of an anterior abnormally developed spine, and two or three other

very much shorter rays. This peculiarly shaped fin has in some localities won for these species the popular title of "Trigger-fishes." Examples of both of these two varieties are among the desiderata yet needed to complete the collection of British species contained in the Museum of Economic Pisciculture. The curious Trunk-fishes, genus *Ostracion*, having their bodies encased in a complete carapace of variously ornamented tesselated plates, are exotic members of the same family, of which one species (*O. quadricornis*) has been doubtfully alleged to have been taken on one or two occasions off the Cornish coast.

FAMILY II.—GLOBE AND SUN-FISHES (*Gymnodontidæ*).

Body more or less shortened; the bones of the upper and lower jaws coalescing in such a manner as to form a trenchant beak without any arming teeth; no spinous dorsal and no ventral fins; the second or soft dorsal, caudal and anal fins closely approximate.

Of the Globe-fishes but one species, Pennant's Globe-fish (*Tetrodon longicephalus*), No. 192, has been rarely captured on the south coast of England and Ireland. Its chief peculiarity lies in its capacity to distend a considerable area of its skin in the region of the thorax, through the imbibition of air or water, into an almost globular shape, after the manner of a huge crop. The surface thus distended is armed with thickly-set defensive spines, leading the way to the tropical Globe or Porcupine-fishes (*Diodon*), in which the entire body is beset with formidable spines, and distensible at will into a spheroidal form. The inflated skins of these fish are largely used by the Chinese for the purpose of making ornamental lanterns. Of the species known as Sun-fishes, included in the same family

group, one variety, the Short Sun-fish (*Orthagoriscus mola*), No. 193, is not unfrequently taken during the summer and autumn months in British waters, the second form, or Oblong Sun-fish (*O. truncatus*), No. 194, being much more rare. Both species share the remarkable feature of having the posterior region abruptly truncated, resembling in this respect an ordinary fish cut in half; the tail is almost obliterated or reduced to a mere frill-like border, continuous with which are produced from above and beneath the large

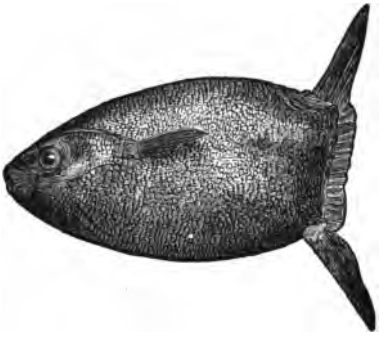

FIG. 25.—SUN-FISH (*Orthagoriscus truncatus*).

equal-sized dorsal and anal fins. Both species attain to large dimensions, a measurement of from six to eight feet, with a weight of several hundredweight, being frequently attained to. Casts of several fine specimens of the short Sun-fish (*O. mola*) will be found in the Buckland Museum. The colours of a young example of this species forwarded alive to the writer from Mevagissey, Cornwall, by Mr. Matthias Dunn, a few years since, were brilliant silver variegated with irregular blotches and bands of flesh-pink.

ORDER II.—*Ganoidei.*

Skeleton partly cartilaginous, partly ossified; the optic nerves forming a chiasma, not decussating; the aortic bulb provided with but a single row of valves; the intestine with a spiral valve; branchiæ free; the gill cavity covered by a gill-cover.

FAMILY I.—Sturgeon Tribe (*Acipenseridæ*).

Skeleton partly cartilaginous; the integument naked, or protected by osseous bucklers; the caudal fin unsymmetrical, heterocercal; the snout produced above and in front of the mouth, four barbels disposed in a transverse row developed from its lower side; the mouth small, toothless, highly protractile; air-bladder large, communicating with the dorsal wall of the œsophagus.

The Broad-nosed Sturgeon (*Acipenser maculosus*), No. 195, and the Common Sturgeon (*A. sturio*), No. 196, are the only British examples of the Ganoid fishes, represented at the present day by some half-a-dozen remarkable exotic genera, but which in older Geological times were among the most abundant of the finny tribes. The Sturgeons are either exclusively inhabitants of fresh water or migrate periodically from the sea into the larger rivers to deposit their spawn. Both of the above-named species attain to a large size, a length of eight or ten feet being an ordinary measurement of the common sort, while the broad-nosed stated to grow to over twice these dimensions. the S ich esteemed by some as an Ir re the two British and other e so as t constitute a most

important fishery, the delicacy known as "Caviare" is prepared from the roes, while isinglass is manufactured from the inner lining of their air-bladders. Living examples of the Common Sturgeon have been frequently acclimatised in aquaria; one over six feet long has now been a resident for many years in one of the larger tanks, sixty feet in length, in the Brighton Aquarium, as also a shoal of small specimens, two of which have been kindly spared by the authorities, and are now on view in the Aquarium Corridor of the Fisheries Exhibition. In captivity they feed voraciously on the common lug-worm

FIG. 26.—STURGEON (*Acipenser sturio*).

(*Arenicola*), using their snouts and dependent barbels with much dexterity in groping for and detecting the presence of their favourite food; this is immediately seized by the protrusible tubular mouth, which, under ordinary conditions, is retracted out of sight beneath the projecting snout. The Sturgeon was originally denominated a Royal fish, and by an Act of Edward II., now in abeyance, but still unrepealed, was claimed as the property of the Crown.

Casts of adult examples of both of the two British species and several preserved specimens will be found in the Buckland Museum.

ORDER III.—*Elasmobranchiata.*

Skeleton entirely cartilaginous; tail unsymmetrical (heterocercal), the upper lobe being the more produced; branchia attached to the skin by their outer margins with usually several intervening gill-openings (deciduous external gills developed in the embryo); the aortic bulb provided with several series of valves; ova large, few in number, impregnated, and in many instances developed within a uterine cavity.

SUB-ORDER I.—*Holocephala.*

Gill-opening single, covered by a fold of the skin; the maxillary and palatal apparatus coalescent with the skull; teeth few in number.

The Arctic Chimera, Rabbit-fish, or King of the Herrings, as it is popularly called (*Chimæra monstrosa*), No. 197, is the only representative of the Holocephalous division of the Elasmobranch fishes taken in British waters, and then upon very rare occasions, it being more strictly an inhabitant of the deep and colder waters of the polar seas. From the ordinary sharks, with which in many anatomical points it closely agrees, it differs most essentially in the possession of a single gill-opening, and in the character of the dentition, the conspicuous teeth being but four in number, two above and two beneath, their contour, in addition to their number, much resembling the incisors of a rabbit. A sharp and formidable spine arms the front border of the first dorsal fin, and in the male a remarkable erectile spiniferous appendage is developed from the front of the head; the upper lobe of the tail, which is very long, tapers off gradually to the fineness of a thread. The

large eyes, which in freshly caught examples are of a brilliant sea-green hue, seem specially adapted for its accredited deep-water habitat. An excellent cast of the Arctic Chimera, made from a specimen captured on the coast of Norway, will be found in the Buckland Collection. A length of from two and a half to three feet represents the ordinary measurement of this species.

SUB-ORDER II.—SHARKS AND RAYS (*Plagiostomata*).

Gill-openings five to seven in number; palatal apparatus united to the skull through the intermedium of a suspensorium; the teeth numerous.

DIVISION I.—SHARK TRIBE (*Selachoidei*).

Body elongate subcylindrical, terminating anteriorly in a more or less pointed snout, beneath which the mouth is situated, and posteriorly in a powerful flexible blade-like tail; gill-openings lateral.

Although usually relegated by the popular mind to the seas of the tropics, a very considerable number of Sharks either permanently inhabit, or more or less frequently visit, British waters. Including the Dog-fishes, whose anatomical structure is essentially identical with that of the larger Sharks, no less than sixteen species claim admission upon the British list, the order assigned to them in the leading ichthyological text-books being as follows:—The Blue Shark (*Carcharias glaucus*), No 198, a rapacious species growing from eight or ten to upwards of fourteen feet in length, not unfrequent off our coasts so far north as the Orkneys during the summer months, and which on rare occasions has been known to attack the human species.

The Toper, or White Hound (*Galeus canis*), No. 199, sometimes attains to a length of six feet, and in shape and aspect much resembles the Picked Dog-fish (*Acanthias vulgaris*), No. 210, excepting that the defensive spines stationed in front of the two dorsal fins are in this species entirely wanting. The Hammer-headed Shark (*Zygæna mallens*), No. 200, common in the Mediterranean and tropical seas, is a very rare visitant to our shores, remarkable for the lateral elongation of the orbital processes of the skull, that communicate to the head its characteristic hammer-like contour, and upon the extremities of which the eyes are developed, the visual range of the fish by this arrangement being greatly increased. The cast of a small exotic example of this species, which grows to a length of ten or twelve feet, will be found in the Buckland Museum. It is usually described as among the most ferocious examples of the Shark tribe, though authentic records seem wanting to show that man has been the subject of its attacks. The Skate-toothed Shark, or Smooth Hound (*Mustelus vulgaris*), No. 201, is among the smaller species, rarely exceeding a length of three or four feet. In common with the Toper and Picked Dog-fish, it has frequently been acclimatised in the tanks of our larger aquaria. In the year 1875 a pair of these fish, male and female, were captured the same night in Mr. Parry Evans' Salmon Weir at Colwyn Bay, North Wales, and secured by the writer for the Manchester Aquarium. Soon after arriving at their destination, the female gave birth to eleven young ones, which, with the exception of one example which was apparently devoured by the male fish, were successfully reared. The name of Skate-toothed Shark has been conferred upon this fish with reference to the flattened tesselated character of the teeth, which more nearly resemble those of the Rays and Skates

than the usually sharp-pointed, trenchant weapons of the ordinary Sharks. The cast of a female with its newly born litter of young, similar to the one just described, is on view in the Buckland Museum. The Porbeagle, or Beaumaris Shark, as it is occasionally called (*Lamna cornubica*), No. 202, is by no means unfrequent on the southern and western coasts of England and Scotland; though rarely surpassing a length of six or eight feet, it possesses all the characters of the most predacious species, and is armed with a very formidable array of trenchant recurved teeth. Several casts of this species are exhibited in the Buckland Museum, and on the opening day of the Fisheries Exhibition, May 12th, 1883, a specimen about four feet long was exposed to view on one of the stalls in the fish market. Among the more remarkable members of the Shark tribe must be mentioned the Fox-Shark, or Thresher (*Alopecias vulpes*), No. 203, the striking feature in which is the enormous development of the upper lobe of the tail, which is shaped like the blade of a scythe, and whose length equals or exceeds that of one-half of the fish's body. This formidable appendage it is asserted the Fox Shark uses with terrible effect in its attacks upon various of the larger Whales, with whom it is said to wage a constant feud, its ally in arms being the Sword-fish (*Xiphias*), which attacks the Whale from beneath while the Sharks, leaping out of the water, fall upon the Cetacean from above. In accordance with the latest observations there is, however, reason to believe that it is another Cetacean the Grampus (*Delphinus gladiator*) that is usually the aggressor and which has been mistaken for the Shark. Casts of the Thresher, including that of an example thirteen feet six inches long, captured in the Mackerel nets off Folkestone in October 1867, may be seen in the Buckland Museum.

The Basking-Shark, or Sun-fish, as it is sometimes incorrectly termed (*Selaché maximus*), is the largest of our British fish, not unfrequently exceeding a length of thirty feet. It makes a regular migration along the west coast of Ireland and western isles of Scotland during the spring months of the year, and on account of the value and quantity of the oil obtainable from its liver is the object in such localities of an important fishery. Although of such enormous bulk, it is a very quiet and inoffensive species, armed with teeth scarcely larger than those of an ordinary Dog-fish. A fine preserved example of this species has been recently added to the collection now in course of transfer from the British to the adjacent New Natural History Museum. The fish takes its names as above given from its habit of basking in the sun at the surface of the water, and under which conditions it falls an easy prey to the harpooners. The Six-gilled Shark (*Notidanus grisens*), No. 205; the Centrina (*Centrina sabriani*), No. 209; the Black Shark (*Spinax niger*) No. 210; the Greenland Shark (*Læmargus borealis*), No. 212; and the Spinous Shark (*Echinorhinus spinosus*), No. 213, are among the larger forms that are but rarely taken in British waters; the cast of a fine example of the last-named species, between seven and eight feet long, will be found in the Buckland Museum. The remaining British Sharks, including the Lesser Spotted Dog-fish, or Rough Hound (*Scyllium canicula*), No. 206; the Larger Spotted Dog-fish, or Nurse Hound (*S. stellaris*), No. 207; and the Black-mouthed Dog-fish (*Pristiurus melanostomus*), No. 208, are all of relative small size, not exceeding from three to four or five feet in length, accustomed to prey upon Crustacea and other animals inhabiting the bottom of the ocean, and are for this reason known as "Ground Sharks." The two first-named species, which are beautifully spotted with

black upon a tawny ground, after the manner of a leopard, adapt themselves readily to the artificial conditions of a marine aquarium, and breed freely in the tanks. Contrary to the preceding forms which are all viviparous, these Ground Sharks deposit eggs, usually two at a time, enclosed in horny cases several inches long, not unlike those of the Skates, but having their extremities produced into long cord-like tendrils which during deposition are wound tightly round stones, sea-weeds, and other submarine objects, the eggs being thus securely anchored until the escape of the young fish. The gradual development of the embryo Dog-fish, which in its earlier days possesses tufted external

FIG. 27.—SPOTTED DOG-FISH (*Scyllium stellaris*).

gills, like a Tadpole, may be distinctly observed through the more transparent egg-cases, and affords one of the most interesting and instructive exhibitions furnished by a well-ordered aquarium. The Spotted Dog-fish are essentially nocturnal in their habits, rarely active, unless when fed or disturbed, during broad daylight, but waking into life with the approach of dusk, and then swimming swiftly to and fro or around their tanks with a peculiarly graceful gliding motion. The eye-coverings in these fish are remarkably complex; within the first or outer eyelid, which closes upwards like that of a bird, is a [illegible]ive envelope, acting as a diaphragm, and w[illegible] day is, with the

exception of a narrow oblique slit, entirely closed over the true eye. When darkness has fully set in, this diaphragm is completely retracted, leaving the eyeball free and gleaming like that of a cat or other nocturnal mammal. This phenomenon, observed by the writer of examples in the Brighton and Manchester Aquaria, may be corroborated by an examination of the specimens now on view in the Exhibition tanks. In the Skates, presently described, it will be found that a very beautifully constructed fimbriated membrane takes the place of the diaphragm that covers the eye of the Spotted Dog-fish.

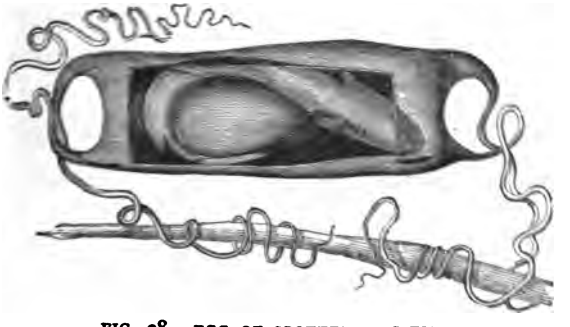

FIG. 28.—EGG OF SPOTTED DOG-FISH.

The last upon the list of the Shark tribe is the Monk-fish or Angel-fish (*Rhina squatina*), No. 214, which in its flattened form, and the great development of the pectoral fins, closely approaches the Rays, the lateral position of its gill-openings, partly hid by the pectoral fins, being however accepted by ichthyologists as of sufficient importance to justify its retention among the present group. Additional evidence in support of its preponderating affinities in the same direction is afforded by its mode of locomotion through the water, observed by the writer of examples in aquaria, to be that of a Shark, being effected by the

powerful sculling action of the oar-like tail, and not by the aid of the pectoral fins, as in the Rays. In recognition of the intermediate positions it occupies between these two groups, it is in some localities distinguished by the name of the Shark-Ray; the Fiddle-fish and the Kingstone are other local titles, the first suggestive of its peculiar form, by which it is locally known to fishermen. Those of the Monk and Angel-fish have been conferred upon it respectively with reference to the fancied resemblance of the rounded head and pectoral fins to a monk's hood and cowl, or of the last-named structures to the wings of a seraph. As acclimatised in aquaria it has been found to be an essentially nocturnal species, reposing sluggishly on the sand or shingle at the bottom of its tank, and unless disturbed exercising its locomotive functions only after darkness has set in. Some fine casts of this species are on view in the Buckland Collection.

DIVISION II.—SKATES AND RAYS (*Batoidei*).

Body greatly depressed; gill-openings ventral, five in number; the pectoral fins usually enormously developed around the flattened trunk; terminating posteriorly in a thin and slender tail, upon which the dorsal fins, if present, are developed; spiracles always present.

The flattened form of the ordinary Skates and Rays with their huge pectoral fins and attenuate tail is too familiar to need elaborate description. Among them, however, are included several highly specialised types which demand closer attention. As such are the Torpedoes, Electric Rays, or Cramp-fishes, as they are sometimes called, of which two species, the Plain Torpedo (*Torpedo hebetans*), No. 215, and the Spotted Torpedo (*T. marmorata*),

No. 216, are occasionally taken in British waters, their head-quarters being the Mediterranean and tropical seas. The remarkable feature concerning these fish is their possession of a complex electrical apparatus. This apparatus, which is developed in equal proportions on each side of the anterior region of the body, consists, as described by Professor Huxley ('Anatomy of Vertebrated Animals'), "of nearly parallel lamellæ of connective tissue, enclosing small chambers, in which lie what are termed the electrical plates. These are cellular structures, on one face of which the final

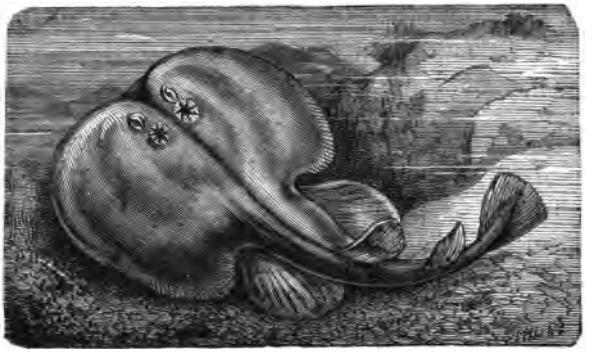

FIG. 29.—TORPEDO (*Torpedo hebetans*).

ramifications of the nerves that supply the electrical organs are distributed. In the Torpedo the nerves of the electrical organs proceed from the fifth pair and from the 'electric lobe' of the medulla oblongata, which appears to be developed at the origin of the pneumogastric." When laid open with the dissecting knife this electrical apparatus presents to the ordinary observer much the appearance of a honeycomb, being composed, as viewed from above, of numerous perpendicularly-set hexagonal compartments, the wax walls of the honeycomb being represented by a gelatinous membrane of extreme tenuity, and containing within them

a transparent fluid of jelly-like consistence. Finer transverse partitions or septa "the electrical plates" subdivide the hexagonal compartments into smaller chambers which subserve the purpose of store cells, after the manner of a Leyden jar, and in these the electricity, converted from excess nervous energy, is stored up for use. There can be but little doubt that the Torpedo employs its formidable battery for disabling and securing food which it is too inactive to capture by ordinary means.

This interpretation is substantially supported by the fact that large active fish, such as Salmon of four or five pounds weight, Eels and other species, have been taken from the stomachs of full-grown Torpedoes, showing no trace of a struggle, as would have been inevitably apparent had the captor been an Angler, Monk-fish, or other ordinary ground-frequenting species of similar size. Several casts of the Torpedo, some illustrating the aspect and position of the electric apparatus, will be found in the Buckland Museum. Of the typical Skates and Rays, genus *Raia*, as many as eight species are included in the British list, these varying among each other chiefly with respect to their markings, the greater or less development upon their upper surface of defensive spines, and in the contour of their snout-like anterior regions. The species that have to be thus enumerated are, the Thornback Ray (*Raia clavata*), No. 217; the Spotted Ray (*R. maculata*), No. 218; the Starry Ray (*R. radiata*), No. 219; the Sandy Ray (*R. circularis*), No. 220; the Common or Blue Skate (*R. batis*), No. 221; the Bordered Ray (*R. marginata*), No. 222; the Shagreen Ray (*R. fullonica*), No. 223; and the Long-nosed Skate (*R. vomer*), No. 224. All of these Rays exhibit in common that remarkable method of locomotion, through the flapping action of their large pectoral fins, which

confers so much grace upon their movements in the water, and which may be more suitably likened to the flight of some heavy-winged bird, such as a Heron, than to the swimming action of an ordinary fish. The simile here suggested is yet further increased by reason of the fact that the long slender tail of the Ray, dependent in the rear while the fish is swimming, bears no inconsiderable resemblance, and fulfils the same function as the long extended

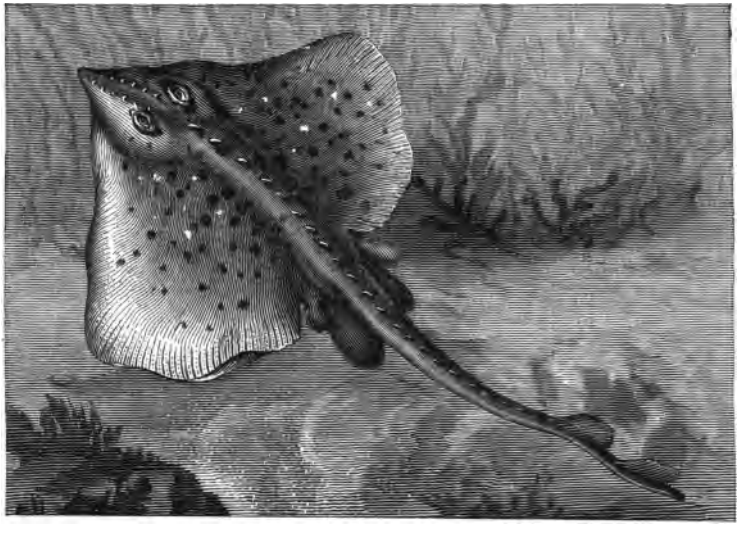

FIG. 30.—SPOTTED RAY (*Raia maculata*).

legs of the Heron or other Grallatorial bird during flight, it being subservent in like manner for balancing and steering purposes. The Rays, like the Spotted Dog-fish, deposit their eggs enclosed singly in large oblong membranous cases, the four corners of which are produced into simple tags like the four handles of a butcher's tray, in place of into long flexible cord-like filaments. These cases, when empty, having the aspect and colour of gutta-percha, and

popularly known as "Skate-barrows," or "pixie's purses," are among the "commoner objects of the sea-shore," left with the flotsam and jetsam of the ocean when the tide goes down.

The Sting Ray or Fire-flaire (*Trygon pastinaca*), No. 225, is remarkable among the Skate tribe from the circumstance that one or two long sharply serrated spines are developed towards the centre of the tail in place of the first dorsal fin. In life, as observed of examples in aquaria, the tail with its spines is elevated above the back after the manner of the tail of a Scorpion, and constitutes a very formidable

FIG. 31.—STING RAY (*Trygon pastinaca*).

offensive and defensive weapon, with which the fish can deal lacerated, extremely painful, and even dangerous wounds. The spines of certain exotic species are utilised by the natives of Polynesia and various savage tribes as barbs for their arrows, spears, and other weapons. A fine example of the Sting Ray is contained among the spirit-preserved series forming the Day Collection, casts being also on view in the Buckland Museum. A close ally of this type, but a much larger and rarer form is the Eagle Ray (*Myliobatis aquila*), No. 226, bearing like the last-named species a formidable defensive spine, but having a

slender tail developed in the form of a cord or whip to as much as two or three times the length of the body; specimens measuring no less than fifteen feet across their extended fins, with a weight of three hundred pounds and upwards, have not unfrequently been recorded. The cast of a small example of this species is included in the Buckland Collection. The last, but by no means the least formidable in point of size among the group now under discussion, is the huge Ox Ray or Horned Ray (*Dicerobatis giornæ*), No. 227, so called on account of the two horn-like processes of the integument that are developed in front of the head. Although small examples measuring but a few feet in breadth have been driven as wanderers to our shores, in the tropical seas which are its native home it attains to the enormous proportions of ten or twelve hundredweight, with a breadth across its expanded fins of twenty or thirty feet. Upon the Italian coasts, where it is known by the title of the Vacca, or Cow, and also that of the Manta-fish and Devil-fish, it is held in great dread by the divers for sponges and coral, whom the fish is said to attack, hovering over and debarring their efforts to regain the surface, and afterwards probably devouring them, the gape of the larger examples, as in certain Sharks, being sufficiently wide as to easily admit of the passage of a human being.

ORDER IV.—LAMPREY TRIBE (*Marsipobranchii*).

Skeleton entirely cartilaginous, spinal column consisting of a thick persistent notochord enveloped in a sheath but devoid of vertebral centra; no real jaws, the mouth circular suctorial, armed with horny teeth, and frequently strengthened

by a basket-like cartilaginous framework; no pectoral or pelvic limbs; branchial apparatus consisting on each side of seven sacs, which open externally by as many distinct apertures and communicate on the inner side with the pharynx.

The Lampreys, which may be said to represent the lowest recognisable order of true fishes, are easily distinguished by their eel-like contour, the peculiar form of their jawless mouths, which are usually so modified as to form a powerful adhesive sucker, by their want of pectoral and ventral fins, and by the numerous gill-openings developed along the sides of the head. Of British representatives of this order there are as many as four species. Of these the

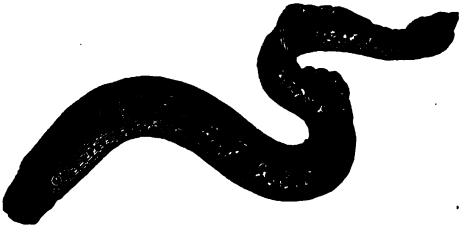

FIG. 32.—LAMPREY (*Petromyzon marinus*).

Sea Lamprey (*Petromyzon marinus*), No. 228, is a large form growing to a length of two or three feet, and mottled with yellow and black much after the manner of the Murœna. Although passing most of its time in the sea, it migrates in the spring months up our larger rivers to spawn, and is often at such seasons taken in large quantities. A fine specimen of this fish is shown in the Day Collection. The River Lamprey or Lampern (*Petromyzon f*
No. 229, a smaller species, rarely e
or fifteen inches, colour slate grey
is still tolerably abundant in the
exported alive in prodigious quant

bait to the Dutch fishermen. Twelve hundred thousand represents the number recorded as having been thus sent away from this river alone in a single year. The Sand-pride or Mud Lamprey (*P. branchialis*), No. 230, is a yet smaller fish about the length of a moderate-sized worm, and not thicker than a pipe stem, that is likewise an exclusively fluviatile form, addicted to burying itself deeply among the mud and ooze of our large rivers, and spawning like its congeners during the spring months of the year. The last of the Lamprey types is the Glutinous Hag or Borer (*Myxine glutinosa*), No. 231, having its mouth furnished with eight cirrhose processes, and so constituted that it can bore its way into the bodies of dead, and some say living fish, upon whose flesh it then feeds, leaving nothing but the bones and skin intact. An example of this species, which is not unfrequently taken on the Eastern counties coast-line, is among the desiderata of the South Kensington Collection.

ORDER V.—LANCELETS (*Pharyngobranchii*).

Primitive spinal axis or notochord extending to the anterior end of the body; no limbs, skull, brains, auditory, or renal organs, as in the higher Vertebrata; the heart a simple tube; the liver succular.

But a single type, the Lancelet or Amphioxus (*Amphioxus lanceolatus*), No. 232, represents this lowest organised, but at the same time exceedingly interesting and important, order of the Vertebrata. It is a compressed lanceolate form exc[illegible]o to three inches in length, perfectly trans- [illegible]ossessing as shown in the accompanying [illegible] eyes, limbs, dermal covering, or other

feature common to ordinary fishes, with the exception that a slender fold of integument representing a rudimentary dorsal fin is developed along the back, and that the body substance is similarly divided by faint oblique lines into distinct muscle regions or "myotomes." The mouth is a largish oval aperture developed beneath the anterior termination of the body, and having its margin bordered with a series of delicate ciliated tentacles. The mouth conducts to a largely dilated pharynx perforated with numerous clefts, the walls

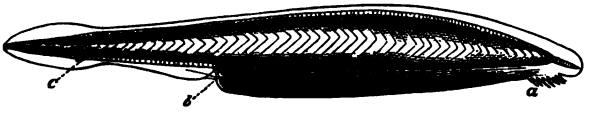

FIG. 33.—LANCELET (*Amphioxus lanceolatus*).

of which are richly ciliated, and have the blood vessels distributed upon them after the manner of the pharynx of an Ascidian. Following upon the pharynx is a simple stomach or gastric cavity that passes into a straight intestine and terminates near the root of the tail in the anal aperture. Such are the leading features of this remarkable animal, which, so far as our present knowledge extends, represents the dawning form or Architype of all Piscine life, and still retains structural features that unite it closely with the lower classes of backboneless animals or Invertebrata.

APPENDIX.

ACCLIMATISED EXOTIC FISH.

About twelve varieties of exotic fish have been introduced into this country either as stock fish for our ponds and rivers, or as interesting or ornamental forms for exhibition in aquaria. Among the first-named category must be mentioned the American Char or Brook Trout (*Salmo fontinalis*), which, as mentioned in a previous page, has so thriven and increased in this country as to now claim a place among our indigenous species, while many interesting hybrids have been obtained between this type and the English River Trout (*Salmo fario*). Another freshwater American species, originally imported into England by the Marquis of Exeter, and which has bred on his estate at Romford, is the Black Bass (*Grystes nigricans*). In its native waters it attains to a weight of six or eight pounds, and is much esteemed both for the table and as a fish affording excellent sport. Some young examples of this species, whose shape and colour in this immature condition are not unlike those of certain varieties of the Ballan Wrass (*Labrus maculatus*), will be found in one of the tanks in the Buckland Museum. Of European freshwater fish, the Pike-Perch, or Zander (*Perca lucioperca*), having the proportions of a Pike with the sharp-spined fins and markings of a Perch, has been successfully acclimatised by his Grace the Duke of Bedford, and living examples have been some years on view in the Brighton Aquarium. The Sheet-fish or Wels (*Silurus glanis*), inhabiting the European rivers east of the Rhine, is

not unlike the Burbolt or Motella in shape, but has as many as six barbels developed from the region of the mouth, two of which are of extraordinary length. Adult Siluri measure no less than five or six feet in length, with a weight of over 100 lbs. Fine casts of such a full-grown specimen transmitted to Mr. Buckland from Berlin, by Lord Odo Russell, are exhibited in the Museum of Economic Pisciculture. Young living Siluri have been successfully imported into this country by the above-named nobleman, and likewise by Sir Stephen Lakeman, while at the time of going to press, May 1883, two or three small examples are on view in the Exhibition Aquarium. From North America, where the family of the Siluridæ is extensively represented, a near ally of the Sheet-fish, the American Cat-fish (*Amiurus cattus*), has been obtained by the writer. One from among several examples so imported in the year 1875, and presented by him to the Zoological Society, is still living in the Fish-house in their Gardens in the Regent's Park. A continental variety of the Carp rivalling the ordinary Gold-fish in the brilliancy of its colouration, but having a shorter dorsal fin, and in contour more nearly resembling a Roach or Chub, is the so-called Golden-Orfe (*Cyprinus orfus*); this variety, which was first successfully acclimatised in this country by the Duke of Bedford, is represented by several fine examples in the Exhibition Aquarium. Another well marked continental variety of the Carp family is the so-called Mirror Carp or Spiegel Carp (*Cyprinus specularis*), remarkable for having one or more lines of very large scales developed along the sides and back, the remaining surface of the skin being perfectly soft and naked. Sometimes these series of scales are altogether absent, when the fish are distinguished by the title of Leather Carp. Living specimens of the Mirror Carp are on view in the Buckland Museum. The European Loach or Thunder-fish (*Cobitis fossalis*) is a third continental species that has been occasionally imported to England.

As curiosities for exhibition in aquaria several small species of Indian freshwater fishes have been brought over

to this country, and with proper appliances for maintaining the water at an equable temperature of about 70° to 80° Fah., such as is afforded in a large conservatory, might be permanently acclimatised. Of the species which have so far been temporarily maintained may be mentioned the Climbing Perch (*Anabas scandens*), remarkable for having its branchial organs so modified and enlarged that it is capable of leaving its native element and moving some distance upon land, it even being asserted to ascend trees in search of insect food. Living examples of this fish were received by the writer some years since from Professor Wood-Mason, of the Calcutta Museum, and preserved examples are on view in the Buckland Museum. The Gourami or Peacock-fish (*Osphromenus*), and the Paradise-fish (*Polyacanthus viridiauratus*), two beautifully coloured species, having their ventral fins reduced to little beyond a single long thread-like filament, have on several occasions been introduced into English aquaria, and are both remarkable for their nest-building habits. The males of the former species, like those of the Sticklebacks, are noted for their pugnacity, and in common with other allied species are kept specially by the natives of the Malay peninsula for fighting purposes. The Electric Eel (*Gymnotus electricus*), a native of Brazil, growing to as great a length as five or six feet, and that even surpasses the Torpedo in its electric properties, has been acclimatised and thriven for some years at both the Brighton and Westminster Aquaria. The organs in which the electric energy is stored up in this fish are, structurally, precisely analogous to those of the Torpedo, but are developed in pairs immediately beneath the skin, one pair along the back of the tail and a second pair along the anal fin. A small member of the Sturgeon family, the Sterlet (*Accipenser ruthenus*), inhabiting the Russian rivers, rarely exceeding a length of three feet, and highly esteemed for the table, has been brought from Russia and successfully acclimatised in the tanks of the Brighton and Manchester Aquaria. Some of the examples now on view in the first-named institution have been resident there for as long a

period as ten years. Two or three specimens of this fish have been recently secured for the Exhibition Aquarium. Examples of a larger Sea-Horse than the very rarely occurring British form, *Hippocampus antiquorum*, are frequently imported from the French coast, notably by Mr. Henry King, of 192 Great Portland Street, for exhibition in our public aquaria. This species, which, in addition to its larger size, is distinguished by the filamentous processes that are developed in a mane-like manner from its head and shoulders, is known by the name of the Branched Sea-Horse (*Hippocampus ranulosus*). A singular monstrosity of the Gold Carp (*Cyprinus auratus*), having relatively large

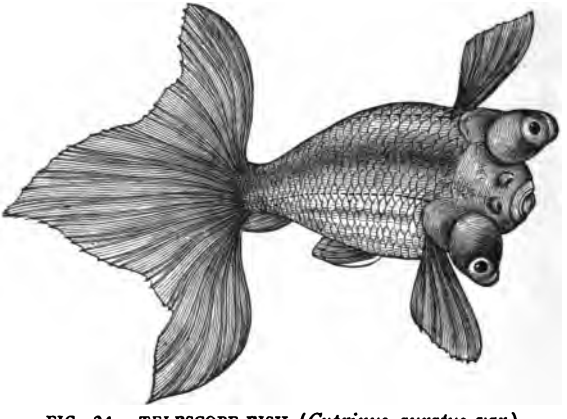

FIG. 34.—TELESCOPE-FISH (*Cyprinus auratus var.*).

projecting eyes and a wide-spreading lobate tail, long since cultivated in China, as is evidenced by its frequent occurrence in the old paintings and tapestry of that country, is not unfrequently imported and shown in aquaria. An excellent engraving of a perfectly proportioned example of this singular variety, as figured in Dr. Gunther's 'Introduction to the Study of Fishes,' and known on account of its projecting eyes by the title of the "Telescope-fish," is, with the kind permission of Messrs. Adam and Charles Black, the publishers of the above work, herewith annexed.

INDEX.

ALLIS-SHAD, 94
American Cat-fish, 124
American Char, 86
Amphioxus, 121
Anchovy, 92
Angel-fish, 113
Angler, 23
Arctic Chimera, 107
Argentine, 82
Armed-Bullhead, 22
Armed-Gurnard, 22
Atherine, 63

Bank's Oar-fish, 62
Barbel, 90
Basking-Shark, 111
Bass, 7
Bearded Ophidion, 76
Bergylt, 17
Bib, 74
Black Bass, 123
Black Bream, 14
Black-fish, 34
Black Pilot, 38
Bleak, 90
Blennies, 56
Blue Shark, 108
Boar-fish, 38
Bogue, 14
Bonito, 33
Boops, 14
Borer, 121
Bream (freshwater), 90
Bream (sea), 13
Brill, 79
Bullhead, 18
Burbolt, 74
Butter-fish, 60

Carp, 90
Cat-fish, 56
Centrolophus, 34
Char, 86
Chub, 90
Climbing Perch, 125
Coal-fish, 74
Cod, 73
Comber, 8
Conger Eel, 96
Cornish Sucker, 54
Corregonus, 87
Coryphœnoid, 77
Crucian Carp, 90

Dab, 80
Dace, 90
Deal-fish, 62
Dentex, 10
Derbio, 38
Diana-fish, 35
Dog-fish, 109
Dory, 39
Dragonet, 49
Dusky Perch, 9

Eagle Ray, 118
Echiodon, 76
Eel, 95
Eel-Pout, 74

Electric Eel, 125
Erythrinus, 13

Father-lasher, 19
File-fish, 102
Fishing-Frog, 23
Flat-fish, 78
Flounder, 80
Flying-fish, 89
Fork-beard, 74
Fox Shark, 110

Gar-fish, 88
Gilt-head, 16
Globe-fish, 103
Gobies, 46
Gold Carp, 91
Golden Orfe, 124
Gold Schlei, 92
Gold Tench, 92
Grayling, 87
Greenland Shark, 111
Grey Mullet, 64
Gudgeon, 90
Guiniad, 87
Gunnell, 60
Gurnards, 20

Haddock, 74
Hairtail, 44
Hake, 74
Halibut, 79
Hebridal Smelt, 87
Herring, 92
Hippocampus, 99
Horned Ray, 119
Horse Mackerel, 36

Jack, 88
John Dory, 39

Lampern, 120
Lamprey, 120
Lancelet, 121
Launch, 76
Leather Carp, 124
Lemon Sole, 80
Ling, 74
Loach, 91
Long Flounder, 80
Lord-fish, 73
Lucky Proach, 19
Lump-fish, 51

Mackerel, 30
Maigre, 43
Megrim, 79
Miller's Thumb, 19
Minnow, 90
Mirror Carp, 124
Monk-fish, 113
Mud Lamprey, 121
Muræna, 97
Myxine, 121

Norway Haddock, 17
Notidanus, 111
Nurse Hound, 111

Old Wife, 14
Opah, 35
Ophidiom, 76

Paradise-fish, 125
Peacock-fish, 125
Pelamid, 33
Perch, 5
Picked Dog-fish, 109
Pike, 88
Pike-Perch, 123
Pilchard, 94
Pilot-fish, 37
Pipe-fish, 98
Plaice, 80
Pocket-fish, 27
Pole, 80
Pollack, 74
Pollan, 87
Pope, 7
Porbeagle, 110
Powan, 87
Power Cod, 74
Prussian Carp, 91

Rabbit-fish, 107
Rays, 114
Ray's Bream, 35
Red Band-fish, 61

Red Mullet, 10
Remora, 33
Ribbon-fish, 62
Roach, 90
Rockling, 74
Rock Whiting, 74
Rough Dab, 79
Rough Hound, 111
Rudd, 90
Ruff, 7

Sail-fluke, 79
Saithe, 74
Salmon, 83
Salmon-Trout, 85
Sand-Eel, 76
Sand-Smelt, 63
Saury Pike, 88
Scabbard-fish, 45
Scad, 36
Sciœna, 43
Sea-Bream, 13
Sea-Bullhead, 19
Sea-Horse, 99
Sea-Snail, 54
Sea-Trout, 85
Serranus, 8
Sewin, 85
Shad, 94
Shanny, 58
Sharks, 108
Sheet-fish, 123
Silurus, 123
Silver Eel, 95
Silver Spots, 82
Skates, 114
Skate-toothed Shark, 109
Skulpin, 49
Smear Dab, 80
Smelt, 86
Smooth Hound, 109
Sole, 80
Solonette, 81
Spanish Bream, 13
Spanish Mackerel, 31
Spinax, 111
Spinous Shark, 111
Spotted Dog-fish, 111
Spotted Gunnell, 60
Sprat, 94
Sterlet, 125
Sticklebacks, 65
Sting Ray, 118
Stone Bass, 9
Sturgeon, 105
Suckers, 54
Sucking-fish, 33
Sun-fish, 104
Surmullet, 10
Sword-fish, 41

Tadpole-fish, 74
Telescope-fish, 126
Tench, 90
Thornback Skate, 116
Thresher, 110
Thunder-fish, 124
Toper, 109
Topknot, 79
Torpedo, 114
Torsk, 74
Trigger-fish, 103
Trout, 85
Trumpet-fish, 68
Tunny, 32
Turbot, 79
Twait-Shad, 94

Umbrina, 43

Vaagmaer, 62
Variegated Sole, 80
Vendace, 87
Viviparous Blenny, 60

Weever, 29
Whitebait, 93
Whiting, 74
Wolf-fish, 56
Wrasses, 69

Zander, 123

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